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WAR-TIME USES OF ANTHROPOLOGICAL SURVEYS

DARWINISM affected the study of the racial classification of man in various ways. It offered a plausible hypothesis to account for the diversity observed within the species, and anthropologists soon realized that new descriptive data would be needed to test the theory at all effectively. The systematic collection of records of the physical characters of samples representing different populations began about 1860. Techniques were laid down defining measurements and observations to be taken on series of living people and skeletons. The characters used earlier were principally certain measurements of the head and body, and records of skin, hair and eye colours. The list was supplemented by blood groups after the War of 1914–18. The advantages of a statistical treatment of both the quantitative and qualitative data are now generally appreciated.

Owing to the lack of any effective international agreement regarding matters of technique and planning, the anthropological records are far less useful than they might have been made with the same expenditure of labour. Nevertheless, they form a substantial bulk of reliable evidence, though ways in which it should be treated and interpreted for taxonomic purposes are still highly controversial. In the past eighty years, anthropological surveys of living populations have been carried out on larger or smaller scales in most parts of the world. The evidence is distributed in a very uneven way, some regions being well described while others are badly documented. In Europe nearly all the investigations have been of a national kind, the two most comprehensive being for Sweden and Norway. Shortly before the present War, Harvard University sent an anthropological expedition to carry out a survey of the people of Ireland, which was almost an untrodden field. The results have not been published yet. England is among the European countries the populations of which are least well known from the same point of view.

It has repeatedly been urged that surveys of the physical characters of national populations should be carried out for other purposes. Most of these come within the scope of 'race biology'. Official demographic and medical statistics give some indication of the biological condition of a people, but they leave many questions unanswered. The announcement that the British Army Medical Service had great difficulty in obtaining a large enough number of men of adequate physique for service in the South African War was a revelation. Much discussion of national degeneration followed, but there was little scientific evidence bearing on the topic. The report published in 1920 on data for recruits collected two years earlier again disclosed a disquieting situation. About the same time special inquiries of limited scope were undertaken which revealed the prevalence of malnutrition and some of its effects on physique.

There is still an urgent need for a survey which will assess the physical fitness and capabilities of the population of Great Britain. Physiological and medical tests and observations are the data principally required in this connexion, but the customary anthropological characters should be recorded as well, since it is necessary to make allowances for racial diversity in interpreting the import of regional and class differences. It is significant that the first major task undertaken by the Swedish State Institute for Race Biology was a purely anthropological survey of 47,000 conscripts from all parts of the country. Knowledge of that kind is of basic importance in many connexions.

The medical information gained from the examination of recruits is of immediate military importance. So also have been the few body measurements usually recorded at the same time. They have been used principally to determine limits of height and weight taken into account when deciding whether men should be rejected or assigned to a particular grade. All fighting services have fixed minimum statures for entrants to different forces. Measurements of recruits collected in several European countries in the past century revealed the fact that there has been a secular increase in the average statures of many populations. Hence it was necessary to change the standards adopted from time to time.

In some countries body measurements have doubtless been used extensively for other military purposes to which there is scarcely any reference in the literature of anthropology or any other science. They should obviously be of assistance in connexion with the supply of clothing and equipment. There are two kinds of problems encountered here. The first is concerned with the provision of things worn by the men. In the case of clothes of ordinary kinds, the ranges of shapes and sizes needed, and the relative frequencies with which they are required, are known to the manufacturers on account of their extensive experience. In the case of articles designed for special purposes, however—such as helmets worn by airmen, or equipment carried by infantrymen—there may be no such guidance. A trial-and-error method of gaining the experience required is likely to be slow and wasteful. Measurements already recorded for anthropological purposes would probably be found to aid particular specifications to greater or lesser extents. If they are not sufficient, it should be profitable to take new measurements on a suitably chosen sample of a few hundred men. In cases where accurate fitting is a matter of considerable importance, a special investigation might be needed to discover whether the manufacture of standard sizes can give satisfactory results, or whether the article should be made to measure.

The second kind of supply problem referred to concerns the allocation of men to confined spaces of particular dimensions, such as the compartments of aeroplanes, tanks and submarines. Ideally, it may be considered most expedient to take body measurements into account when designing such conveyances. If they have been made with no detailed regard to that factor, then it is still desirable that body measurements should be used in deciding which men should be assigned to particular duties, so that their accommodation, and the efforts they make in reaching controls, cause no avoidable discomfort or strain. Metrical data available could certainly be used with advantage in this connexion, but additional records might be needed to give entirely satisfactory results.

It may be suggested that there can be little practical advantage in discussing these matters now, since nothing approaching a comprehensive anthropometric survey of the population of Great Britain, or any large section of it, has ever been undertaken. Neglect of such research can be attributed partly to good fortune in being almost free from racial disputes and animosities within Great Britain, and partly to the fact that only small fighting forces were maintained in peace-time. A committee of the Ministry of National Service published a report on part of the evidence collected by the medical boards during the War of 1914–18. Data were included for three measurements—height, weight and "chest expansion"—but the way in which they are presented is statistically inadequate. Officialdom has cared little for these things.

In June 1939 a committee of the Royal Anthropological Institute was set up for the purpose of urging the authorities to take advantage of the opportunity offered of collecting scientific evidence in connexion with the medical examination of recruits called up under the Military Training Act. Its principal concern was in advocating that a few body measurements and observations should be taken on some 30,000 men, to obtain an adequate knowledge of the racial constitution of the population of England, Scotland and Wales. Repetition of the measurements was urged, so that the effect of training and standardized diet on physique could be estimated. At the same time, efforts were made to interest certain other bodies which might have collaborated in the inquiry and extended its scope by adding tests and observations of physiological and genetical significance. The outbreak of the War led to the suspension of negotiations which had encouraged the hope that the scheme would receive official backing. Attempts to revive it later were unsuccessful, although the information which might have been obtained by such means was needed more urgently once hostilities had started.

In some respects nothing can compensate for the absence of an anthropological survey. If it is lacking, the diversity within a population due to differences in the origins of its component sections is unknown, and the extent to which any regional or class differences should be attributed to the racial factor must remain a matter of surmise. In spite of these limitations, it is possible to apply some of the data obtained from the survey of one country to the population of another country, to give the kind of information required in connexion with supply problems. For example, the body (excluding the head) measurements of the populations of Western Europe indicate distinctions in size rather than shape. So far as is known, the relative proportions

of the limbs and trunk, or segments of them, are remarkably constant for these populations, and a close approach to equality is also found in variation and correlation. If data for stature, but for no other character, are available for a particular one of the countries, then it is possible to predict a great deal of information regarding other characters of its members by applying results derived from the surveys of other countries. This is a statistical matter, and the scope and accuracy of the predictions referred to could be investigated adequately by treating extensive material available in the anthropological literature.

The population of the British Isles has remained unsurveyed by anthropologists, though records of the statures, at least, of large numbers of men of military age must have been determined in recent years. It is fortunate that extensive anthropometric surveys have been carried out for two allied populations, namely, the Swedish and Norwegian. In fact, these two have been better described in the respect considered than any others in the world. With proper reservations, the results for them could be applied to men from the British Isles to give information required for military purposes. There are several other ways in which knowledge and experience gained by physical anthropologists might be applied immediately to certain military problems in the interests of economy and efficiency. It may not be proper to ask what has been done already in this direction, but there can be no impropriety in suggesting that this is a matter which should be given careful consideration by those responsible for the Government's policy on the use of scientific and technical resources.

The need seems to be for an advisory committee which could deal with all questions of the kind referred to. Such a body should include anthropologists with knowledge of the relevant literature and experience of techniques used in measuring human beings, and statisticians who would ensure that the data were used in the best way. One of their first tasks might be the reduction of body measurements already taken of men serving in the Fighting Forces. Information derived from them should be presented in a concise and convenient form to those requiring it who are concerned with production and the assignment of men to particular duties. The value of published anthropometric records for the same purposes could also be considered, and the committee might seek permission to use the data collected in certain unpublished surveys of sections of the British population which have been carried out for academic purposes. It could be called on to deal with any new problems falling within its scope, and should be given power to undertake new investigations involving the measuring of samples of the populations concerned. The primary aim would be the speedy solution of problems connected with immediate war-time needs; but it is not to be doubted that the information and experience gained would later be found to be of scientific value in elucidating certain problems of medicine and race biology which are also of great importance to the State.

WORLD CO-OPERATION IN PRODUCTION, CONSUMPTION AND DISTRIBUTION

SIR STAFFORD CRIPPS'S address on July 25 at the Conference on Mineral Resources arranged by the Division for the Social and International Relations of Science of the British Association was noteworthy as an indication that the Government is willing and eager to meet the challenge of a remarkable series of speeches recently made by leading American statesmen. The views expressed by Mr. Wallace, Mr. Milo Perkins and Mr. Sumner Welles in May, by Mr. Winant at Durham in June, and by Mr. Claud Wickard, Mr. Dean Acheson and Mr. Appleby in July, all of whom are intimately concerned with the formulation of American policy, may be taken to represent official thought in the United States on the problems of post-war reconstruction. Sir Stafford Cripps, in welcoming these beginnings of an interpretation of the generalities of the Atlantic Charter, was clearly speaking for the Government, and in promising "willing co-operation along the paths which they indicate", he carried a stage further the promise made earlier in the same week by Mr. Eden and Sir William Jowitt.

The keen interest in these pronouncements betokens the general sympathy in Great Britain with the American agreement and the desire that British leaders should take their full share in formulating future policy on these lines. In Great Britain as in the United States, war is seen as part of a continuous process the roots of which lie deep in poverty, insecurity, starvation and unemployment, and this War will not be really won until the deep causes of war have been uprooted. As Mr. Winant says, this is no short-term military job: "To crush fascism at its roots we must crush depression democracy. We must solemnly resolve that in our future order we will not tolerate the economic evils which breed poverty and war. This . . . is part of the war. . . ."

This new thesis, this deeper view of social and international responsibility, which goes down to the foundations of society in seeking to discover the causes of such manifestations of social disease as totalitarian war, is quite incompatible with isolationism, which it would eliminate, not only on the grounds of world solidarity and comradeship but also of plain self interest. It involves a moral revolution which Sir Stafford Cripps did well to emphasize. Warmly as these views are welcomed, it would be a disaster if there were any failure to understand the sacrifices and changes which will be demanded if the principles of the Atlantic Charter are to become more than pious aspirations. The reports of the Chambers of Commerce, the National Union of Manufacturers and the Federation of British Industries, all issued in the same period, are both measure and warning of the opposition, the prejudices and the difficulties which have to be overcome.

It is, of course, only in broad outlines that the solution is sketched in the speeches made by the American statesmen. Mr. Wallace, referring to

America's opportunity, suggests that the century on which we are entering will be known as the century of the common man. It may be America's opportunity to suggest the freedoms and duties by which the common man must live; and modern science, when devoted wholeheartedly to the general welfare, has in it potentialities of which we do not yet dream. But the will to peace and the continued co-operation of the United States and Britain form the political framework. No nation will have the God-given right to exploit other nations. Older nations will have the privilege of helping younger nations to start on the path to industrialization, but there must be neither military nor economic imperialism, and modern science must be released from German slavery. There can be no privileged peoples, and there will be the supreme duty for the citizen of sacrificing the lesser interest for the greater interest of the general welfare. Moreover, as Mr. Cordell Hull puts it, we must no longer ignore the simple but fundamental fact that the price of peace and of the preservation of right and freedom among the nations is the acceptance of international responsibility.

Mr. Welles, in his address, suggested broadly a long armistice, the disarmament of the aggressors, a United Nations police force, and finally the United Nations as the nucleus of a world organization to determine the final terms of a just, an honest and a durable peace as successive stages. This approach to political and military security springs from that new conception of the deep causes of war and of the new and dynamic conception of post-war relations which finds such vivid expression in Mr. Winant's great speech at Durham. The scientific and economic resources which produce the weapons of war can produce in as great a measure the instruments of peace.

"We have enough technical knowledge and organizing ability to respond to this awakening of social conscience. . . . When war is done the drive for tanks must become a drive for houses. The drive for food to prevent the enemy from starving us must become a drive for food to satisfy the needs of all people in all countries. The drive for physical fitness in the Forces must become a drive for bringing death and sickness rates in the whole population down to the lowest possible level. The drive for man-power in war must become a drive for employment to make freedom from want a living reality. The drive for an all-out war effort by the United Nations must become a drive for an all-out peace effort based on the same co-operation and willingness to sacrifice."

It is not beyond our technical or spiritual capacity, Mr. Winant continued, to have these basic things, and his speech gives noble expression to the expansive, purposeful concept of economics which underlies the new American outlook, the philosophy of what Mr. Sumner Welles calls "the frontier of human welfare". The key is expanding markets, a "mass consumption great enough to use mass production", "a future planned in terms of increase and not curtailment". Within the broad framework, private enterprise and free trade—the progressive scaling down of trade barriers and the end of all discriminating measures—are to be the chief instruments of economic advance, though some measure of Government control is envisaged, and Mr. Milo Perkins speaks of "a bold and daring use of long-term credits by Governments entering fields where private finance cannot enter without taking risks that are too great to take with other people's money".

There can be no doubt as to the revolutionary character of the policy advanced in these speeches. They represent a new conception of world order and an inspiring attempt to reinterpret democracy in terms of the twentieth century situation and to extend its meaning in the economic and social sphere much as Lord Elton has done in "St. George or the Dragon". But it must be recognized that while this call for a co-operative venture, broadly based on the idea of the United Nations, comes from the progressive elements in the United States, there are powerful interests as well as many individuals who do not accept the thesis of co-operation.

For this reason the speeches of Sir Stafford Cripps, Mr. Eden and Sir William Jowitt were specially welcome. Sir Stafford Cripps rightly emphasized the moral revolution which is required if the principles of the Atlantic Charter are to become more than mere platitudes. Behind our scientifically prepared plans there must be, he urged, the inspiration of our deepest religious convictions. That will carry us along the road on which our feet have already been set in developing the plans of the United Nations for their war effort—the subordination of private and national interests to the public and international good.

The determined change of outlook from that of competition to that of co-operation will be as imperative after the War as for its prosecution, and without that outlook we may fail once again to carry over into the work of building the peace the organization for pooling material and experience developed for winning the War. Much of that may well serve eventually as the foundation of a permanent system of international management, and this series of speeches in Great Britain and in the United States of America should be welcomed first for its contribution to the education of public opinion to the sacrifices in private and sectional and national interests which will be involved. Neither Mr. Eden nor Sir Stafford Cripps failed to indicate the extent to which it is in the hands of the people of both countries how far this great experiment of Anglo-American co-operation can be continued after the War, and the necessity for a moral basis.

In associating himself with the hopes inspired by the American speeches, Mr. Eden pointed out that the solution of this problem of organizing full production and equitable distribution of what is produced would demand not only hard work and goodwill but also political invention of a very high order. The new problems cannot be solved along the old lines. In view of the caution and conservation of some of the industrial reports, it is all the more encouraging that Lord Simon, speaking in the House of Lords, should declare that we do not intend to be bound by the orthodoxies of the nineteenth century,

and he emphasized that passage in President Roosevelt's report to Congress on June 11 on Lend-Lease operations in which the President asserted that the financial costs of the War can and should be met in a way which will serve the needs of lasting peace and mutual economic well-being; he also declared the Government's full agreement with the statement and its conviction that it provides a firm and solid basis for co-operation with the United States in winning the peace. The principles of expanding consumption and rising standards of living are also discussed by Mr. Walter Elliot in a recent thoughtful article in which he elaborates the theme of making them the foundations of an ordered and prosperous international community after the War, starting from the point made by Mr. Milo Perkins that our civilization is commodity-rich and consumption-poor. The interest aroused by the British Association Conference on mineral resources and the Atlantic Charter shows how public opinion in Great Britain is becoming aware of what is involved, and is prepared to support that survey of needs which must follow the research into the extent of world resources, of the methods of making them available and of placing them at the disposal of those who need them.

All this is required as a basis for action, and beyond this question of production there lie the even more baffling problems of distribution and consumption. The recent speech of Mr. Nash, Finance Minister of New Zealand, who had early suggested the creation of a World Reconstruction and Development Council through which a positive programme could be mapped out for carrying on a world of peace, contained a friendly warning which we do well to heed. He referred to our failure to give full weight to post-war reconstruction and development, which is the major aim of a large and influential section of the American people. Moreover, his concern that the whole management of the national war effort is being seriously handicapped by excessive reluctance to interfere with existing channels of production and trade applies equally to reconstruction.

The discussion on economic reconstruction after the War, opened by Mr. R. G. Glenday before the Royal Statistical Society on March 17, which has now been reported in the *Journal* of that Society, makes a timely appearance as a corrective to facile optimism which might be engendered by these pronouncements. Mr. Glenday insisted that changes in the business environment must be scientifically analysed and understood before any useful work could be done in planning for post-war reconstruction. He suggested that a factual examination of the condition of Britain's economic environment during the two pre-war decades would show that the change from Free Trade to Protection in 1931 was largely forced upon us by influences outside the individual control of governments. The major factors in precipitating this economic revolution, of which the present War should be regarded as part are, in Mr. Glenday's judgment, the closing of the age of territorial expansion, and the slowing down in the rate of population growth in the more developed and wealthier countries, coupled with continuing expansion in the less mature; and the failure to appreciate that, even though an economic system may not be consciously planned, it must in its process of growth conform to certain rules of order and structure if it is to avoid breakdown. In particular, the rates of growth of its separate parts must be kept in proper relation to one another, and for every structure there will be a most convenient size.

Mr. Glenday was clearly somewhat pessimistic as to the ability of industry to continue automatically to provide expanding avenues of employment, but while he pointed out correctly that the problem is that of creating new avenues of employment fast enough to absorb those thrown out of work by technological developments of a labour-saving kind, he appeared, as Prof. A. C. B. Fisher observed, to accept as axiomatic without further question that the obstacles he indicated were irremediable. Mr. Glenday did indeed suggest that the new comradeship of effort brought into being by the War may be the only solid foundation that we shall possess on which to build that new world for which so many are yearning, but his reference to the Atlantic Charter was scarcely constructive. Both Sir William Beveridge and Mr. Stanley Jevons joined issue with Mr. Glenday on these points, as indeed did Sir Gwilyn Gibbon, in whose brief appeal for concrete proposals rather than generalities lie the untold possibilities of further scientific advances. Sir William Beveridge, speaking from the chair, insisted that it is in our power to abolish want and to cure the evil of urban congestion, provided that we win the War and make such a reasonable contribution towards winning it; that the rest of the world would be friendly; that the nation wills these changes sufficiently to override the various vested interests; and that the changes are adequately planned. The transition problems would undoubtedly be harder to deal with at the end of this War, and Sir William urged that we should pay at least as much attention to problems of which the solution is within our power as to those of which the solution requires an international agreement.

There should be a generous response to the wider understanding, the quickened sense of human sympathy, and recognition of the common purpose of humanity which finds expression in both British and American speeches, and men of science will be able, by virtue of their training and outlook, to bring careful scrutiny to bear on the concrete proposals which may be formulated. But if scientific men, who have been brought up in an atmosphere of international co-operative development, can, as Sir Stafford Cripps pointed out, do much by their example and advice to create this new and challenging spirit among the free peoples of the world, there is one contribution they are supremely competent to make. From none better than from those who have devoted themselves to science, to the search for truth, can the free peoples acquire the habit of facing change fearlessly and bringing to the solution of our great problems of production, consumption and distribution that same adventurous spirit and willingness to accept new ideas and new ways by which science has won its triumphs.

FACTORY INSPECTORS AND THEIR WORK

Factory Inspection in Great Britain

By Dr. T. K. Djang. (London School of Economics and Political Science: Studies in Political Science and Sociology, No. 2.) Pp. 256. (London: George Allen and Unwin, Ltd., 1942.) 12*s.* 6*d.* net.

WHEREAS the work of the factory inspectorate in Great Britain has been very little affected by the transfer of the Factory Department in June 1940 from the control of the Home Office to that of the Ministry of Labour and National Service, the transfer indicates the great importance of factory inspection at the present time, and this first full-length study of the system to be published in this country is opportune. Dr. Djang's book traces the history of the inspectorate, describes its organization and explains the functions and methods of the inspectors. Moreover, the book is admirably annotated and is of real value, not only for an understanding of the work of factory inspection from the point of view of the general citizen, but also as a guide to many of the regulations under the Factory and Workshops Act and to the functions of the inspectorate for those who, in war-time, have been brought into closer contact with them. The bibliography is comprehensive and well arranged, though it might well have included more explicit reference to the excellent review of the work of the inspectorate during 1833–1932, which appeared in the annual report of the Chief Inspector for the year 1932. In the main, Dr. Djang's book is descriptive rather than critical, but the picture he gives leaves no one in doubt that the success of the factory inspectorate in Great Britain has been due largely to the inspectors themselves and to the extent to which they have succeeded in securing the co-operation of both employers and employees. There could scarcely be a better illustration of the value of the principle that in legislation the channels of assent should be dug deep.

It is a tribute to the wise use the inspectors have made of the great powers they possess that they succeeded in establishing so speedily their position as rather that of expert advisers than mere vigilance officers. One of the most interesting aspects of the factory inspection service is, indeed, the example it affords of the application of expert advice on matters of industrial and indeed public welfare. For this reason alone, Dr. Djang's book should be of wide interest to scientific workers, and not the less for the illustration it gives of the value of the system in educating both factory workers and the general public. The wise use of publicity made by the Factory Department, to which Dr. Djang directs particular attention, is only now becoming fully recognized, as indeed is indicated in the recent movement for the establishment of production committees and other methods of promoting industrial morale.

A further factor in the success of the system on which Dr. Djang lays some stress is the utilization of outside expert assistance. The Factory Department has worked in close collaboration with the National Institute of Industrial Psychology, the National Safety First Association, the Industrial Welfare Society, the Home Office Industrial Museum and the Industrial Health Research Board, of which only the last two are Government establishments. The work of the Department is probably weakest on the research side, and several recent reports have commented on the unsatisfactory state of research in the field of industrial health, notably those of the Select Committee on National Expenditure and of the British Medical Association's Committee on Industrial Health in Factories. Dr. Djang suggests that, to avoid overlapping, all research work on factory health and welfare should be entrusted to the Industrial Health Research Board, except that which the Factory Department considers could be conducted by the factory inspectors with greater convenience and better results. As to the need for greatly extending the vigour and resources with which such work is prosecuted, Dr. Djang's book leaves no room for doubt, and the Industrial Health Research Board should clearly be used as the Select Committee recommends and endowed with adequate resources. When all allowance has been made for the research in this field which the work of the Factory Department has already stimulated on the part of private firms, the value of such a central research organization cannot be questioned. Moreover, Dr. Djang's book emphasizes once more the extent to which the real problem of safety and health in industry is centred in the small firms where the management possesses neither the technical knowledge nor resources to cope with the problems unaided and unguided.

The suggestions which Dr. Djang himself advances for the improvement of the service are somewhat unequal. Of those affecting the reorganization of the Factory Department itself, those for investing the Chief Inspector with wider powers inside the Home Office than he at present wields, and in regard to the provision of an effective central information service, are the most convincing. Dr. Djang does not indeed mention some of the prime needs which the latter department might serve. The collection and systematization of information on accidents and matters affecting industrial health and safety are far from satisfactory, and the field is still very imperfectly covered, even from published literature, by existing periodicals. A central information department such as he suggests, which could surely count on all sources of official and unofficial as well as published information, should make a very real contribution to the important field of industrial health and accident prevention. There is nothing on the chemical side corresponding with the "Index Medicus", and the utility of the latter is very seriously impaired by the indifference to such matters as chemical nomenclature of medical men and their periodicals.

Dr. Djang also suggests the encouragement of foreign travel by the inspectors and the transfer of medical examination of young persons for factory employment to school medical officers, with regard to which it should be noted that an important section of medical opinion considers that the duties of the school medical officers can now largely be transferred to the general practitioner. Again, while chemists are already often to be found in the ranks of the inspectors, it is difficult to see what would be gained by the formation of a specialized branch of chemical inspectors as suggested by Dr. Djang, or what the recruitment of a section of industrial psychologists could do that could not be done equally well or better by means of the existing relations with the National Institute of Industrial Psychology. Of other suggestions made by Dr. Djang may be noted his

plea for more educational work in the factories among the workers, employers and the general public, the study of labour problems from a wider field than that of the factory, and closer co-operation between the Factory Department and the International Labour Office. Mr. W. A. Robson's admirable introduction directs attention to an important point upon which the success of the system, however, may largely depend, although it is almost passed over by Dr. Djang, namely, the action of the courts in enforcing factory legislation, although the book includes examples of the failure of magistrates adequately to enforce the law and impose penalties for its breach.

As a contribution to the wider education of public opinion and the sympathetic understanding of the work of the Factory Department, upon which the effective support of its work, either in the factory or on the bench depends, this volume should be warmly welcomed. From scientific workers it well merits further attention as a highly suggestive study of a system in which scientific officers can render technical service to the State on terms which permit them to retain their professional independence and integrity. R. BRIGHTMAN.

ROMANTIC GEOLOGY

Biography of the Earth

Its Past, Present and Future. By Prof. George Gamow. Pp. xiv+242+27 plates. (New York: The Viking Press; London: Macmillan and Co., Ltd., 1941.) 12*s.* 6*d.* net.

IN his book on "The Birth and Death of the Sun", Prof. Gamow revealed himself as a witty and enthusiastic writer with a remarkable flair for successfully popularizing current problems of stellar evolution. He has now applied his lively style of exposition to the life-story of the earth. The book deals broadly with the age and origin of the earth; the birth of the moon; the internal structure of the earth; the origins of mountain ranges and continents; climatic changes; the origin and evolution of life; and the final melting of the earth "in the last desperate explosion of its dying parent"—the sun. The narrative is as vivid and exciting as before, but this time, unfortunately, it is no longer sustained by an adequate background of expert knowledge. In consequence the book is seriously marred both by carelessness as to facts and by an uncritical adoption of many highly speculative hypotheses.

Thus the old view that the Pacific is the scar left by the birth of the moon is accepted—and correlated with the restricted area of the continental masses—without giving the reader any hint of the grave difficulties which stand in the way of this otherwise attractive solution of one of the fundamental problems of geology. Nor is any mention made of alternative hypotheses bearing on the origin of the continents. The author does not appear to have heard of the convection hypothesis, as he fails to mention it either in this connexion or in relation to any of the other problems raised by the major relief and pattern of the earth's surface. Few geologists would now agree with Gamow that "there is hardly any doubt" that great mountain ranges are wrinkles of the crust formed in response to the contraction of the underlying plastic layers. Indeed, the remarkable illustrations on p. 119, purporting to show how mountains are formed, and recalling Descartes's highly erroneous conception of mountain structure (NATURE, July 2, 1938, Suppl., p. 26), clearly demonstrate that the process, as imagined by Gamow, produces nothing remotely like actual folded mountains.

It is a pity that the book was not 'vetted' by a geological friend before publication. Apart from controversial matters, we might have been spared "metamorphized" for *metamorphosed*; "crumbling" for *crumpling*; and such infelicitous statements as "the volcanic eruptions . . . were ejecting masses of molten granite". Occasionally the author is more humorous than he intended to be. On p. 145, for example, he tells us that "the name 'Cambrian' indicates simply that the deposits of that period were first discovered and studied in Cambridgeshire (England)". Another gratuitous blunder is the statement (p. 186) that Gunz, Mindel, Riss and Würm are the names "of the geologists who studied various advances of ice and after whom these periods are often called".

Read as a 'thriller', Gamow's book is highly entertaining; but the reader who knows little geology to begin with must be warned not to take it too seriously. As an imaginative biographical novel it has undoubted merits and teachers will scarcely fail to profit from its originality of treatment. But as a scientific description of the earth's evolution it is in many respects inaccurate and misleading. A. HOLMES.

LAND DRAINAGE

The Principles of Field Drainage

By H. H. Nicholson. Pp. xi+165+12 plates. (Cambridge: At the University Press, 1942.) 12*s.* 6*d.* net.

BEFORE the outbreak of war the National Farmers' Union estimated that a quarter of the farm land of England and Wales could be improved by drainage. Since then a series of measures taken by the Ministry of Agriculture enables drainage work, approved by county war agricultural executive committees, to receive a 50 per cent Government grant. A start has been made on this urgent work but much still remains to be done, and a book on the principles of field drainage is to be welcomed at this time.

Mr. Nicholson and his colleagues in Cambridge have made a special study of the drainage of an area of heavy gault clay soil acquired by the University Farm in 1930, in a derelict state, and afterwards rehabilitated by mole drainage. Their careful observations of the effects on the soil structure produced by the passage of the mole plough points the way to large-scale improvement of our heavy lands by mole drainage now that the development of the powerful track-laying tractor has reduced the cost. They found that this clay soil is fissured to the depth of the channel for a distance of two or three feet on either side of it. This observation has helped to elucidate the process by which drainage water reaches the mole channels. Clay subsoils always tend to return to their natural condition, and mole drainage is essentially a cultivation operation which must be repeated at intervals. As such, it is a means by which a system of tile drains at a lower level may be kept in operation or even restored to working order.

The author does not deal with the technicalities of surveying or of drainage engineering. His aim has been to interest and assist those who have to devise, advise on, and supervise works of field drainage. He classifies the conditions under which ditches and drains are needed and discusses the different ways in which drains are laid. An account of the moisture properties of soil leads to a general description of the way field drains work.

While part of the text is new, several sections are reprints of articles and leaflets published from 1936 onwards. In consequence of this method of compilation there is unnecessary and tiresome repetition. A more logical development could have been achieved had the whole been written anew. Nevertheless this little book can be thoroughly recommended to the public for which it is written. It is well illustrated by plates and text-figures and is a valuable addition to the scanty bibliography of an important subject.

R. K. SCHOFIELD.

APPLICATION OF THE STUDY OF VIBRATION TO ENGINEERING DESIGN

Fundamentals of Vibration Study

By R. G. Manley. Pp. xii + 128. (London: Chapman and Hall, Ltd., 1942.) 13*s*. 6*d*. net.

ACCORDING to the author's preface, this book is intended to be an introduction to vibration theory. The result, however, is in some respects not so much an introduction as a summary of material that is more amply discussed in the standard treatises.

Beginning with one degree of freedom and the effects of forced vibration and damping, the author passes on to two degrees of freedom, many degrees of freedom, continuous systems and complex vibrations. What is said about these matters is doubtless perfectly sound, but a book of this type stands or falls by the method of presentation rather than by the matter presented, and it must be recorded that the method here adopted, apart from a little amplification here and there, follows closely that of the standard text-books on the subject. It may be objected that the difficulty of presenting a subject of this nature from a new angle is a very real one, but the fact remains that there is little here to give the learner a clearer insight into vibration theory than he can pick up from the fuller work of Den Hartog, for example.

A more serious criticism of this book is that the author attempts too much. He tries to expound vibration theory and the necessary mathematics at the same time. It just cannot be done. According to the author, "no previous knowledge of differential equations is assumed, this troublesome part of the theory being dealt with by the powerful and easy method of operators" (which only means the standard D notation) and only a little more than matriculation mathematics is necessary. In view of the fact that the treatment covers such matters as the differential equation of the beam flexure and the use of Fourier series, the above statement is misleading. The gap is supposed to be bridged by a five-page appendix on "Some Pure Mathematics", and an eight-page appendix on "Some Applied Mathematics"; but the bridging is wholly inadequate.

As the avowed object of this work is to smooth the path of the beginner it is a pity that obsolescent, if not obsolete, units like poundals are mentioned; neither the engineer nor the scientific worker has any use for the poundal. Also one feels that the introduction of a mass unit equal to the mass of 386 lb. is more confusing than helpful. What is wrong with the slug, that is, the mass of 32·2 lb.? The learner will have no difficulty in converting inches to feet when I and E are given in inches.

One curious error must be pointed out, as it will most certainly confuse the learner. On p. 8 we have the statement

$$\text{"}m = \frac{\text{lbs.}}{g} = \text{lbs. ins.}^{-1}\,\text{sec.}^{2}\text{"},$$

Obviously the symbol g stands here for the *ratio* of gravity acceleration to unit acceleration and is non-dimensional, so that after division by g the dimension is still that of mass, although now in slugs instead of pounds. This error is repeated twice in Appendix II where we find the statement,

"1 lb. wt. = g poundals,
where g has the value 32·2 ft./sec.^{2}".

Clearly, for plain dimensional consistency this ought to read, "where g has the value 32·2".

The inclusion of a few exercises at the end of each chapter is a good feature that is enhanced by printing the answers at the end of the book.

PASTURE MANAGEMENT

Back to Better Grass

By I. G. Lewis. Pp. 68. (London: Faber and Faber, Ltd., 1942.) 3*s*. 6*d*. net.

THE author has succeeded in presenting a brief but very useful and readable guide to success in the formation and management of pastures, or rather, leys. The ley is of vital importance in Britain to-day, from the points of view both of the nation and of the individual farmer, who should aim at maintaining the fertility of his land, while producing at a high level, and making satisfactory profits. The author lays emphasis on the factor of fertility. By proper manuring, cultivation, and the use of suitable seeds mixtures, highly productive swards are obtained, which maintain a large head of stock, which, in turn, produce a well-dunged and urinated sod; when this is ploughed, heavy arable crops result. Such is rotational farming, which is the only true basis of successful agriculture in Britain.

The author discusses how success can be achieved at each stage, beginning with the preparation of the land for the seeds mixture, and ending with the management of the sward by correct grazing. Useful chapters are given on the selection of seed of the right strains, on the time to sow, and whether to use nurse crops; and the book ends with a useful list of seeds mixture prescriptions for leys of various duration and classes of soil.

The book is very practical, and combines the valuable experience of the scientific man with that of a commercial man who was prepared to stake his career on the soundness of his advice. It is, perhaps, unusual to direct attention to a writer's experience, but the fact that the author set up in business as a 'consulting agrostologist'—the first business of its kind in the world—adds greatly to the value and interest of this book.

DARWINIAN EXHIBITION IN MOSCOW

By SIR ARTHUR KEITH, F.R.S.

I HAVE had the privilege of reading a series of messages cabled by Mikhail Petrov to the president of the Linnean Society in which a description is given of an exhibition now displayed in the Zoological Museum, Moscow, to illustrate phases in the life and work of Charles Darwin. The exhibition, which has been organized by Prof. Turov, director of the Museum, and his staff, is on a scale beyond anything ever attempted in Great Britain or in any other country; in the words of M. Petrov, it "symbolizes the ever-growing cultural relations of two friendly nations who are united in a struggle against Nazi barbarism".

The exhibition begins with illustrations of Darwin's home life in Shrewsbury; passes on to his life and work on board the *Beagle*; then there follows what may be described as an objective account of the evolution of Darwin's masterpiece—"On the Origin of Species". The structure and distribution of coral reefs receives the fullest treatment. These are only a few of the sections of this exhibition, which is designed to meet the needs of the public rather than of the expert and is evidence of the intimate place given to Darwin and his works in the cultural life of Russia. Nor is this taste for Darwinism an affair of the moment; in these pages (NATURE, April 23, 1932, p. 606) was recorded the signal honour done to Darwin's memory by the Soviet Government on April 19, 1932—the fiftieth anniversary of his death. That day "was declared a public holiday in the U.S.S.R." Is it not a strange thing that our aggressive enemy should have domesticated Shakespeare in Germany while our Russian ally has taken to her heart Darwin—so often and so wrongly accused of being an instigator of war? Tolstoy has won wide homage in English-speaking countries; we in Great Britain must bestir ourselves if his great merits are to receive the recognition that those of Darwin have met with in the U.S.S.R.

There is another aspect of the Moscow exhibition which deserves attention. The reception which the "Origin" was accorded by the leading men of science in Russia during 1861–64 is illustrated by extracts from their writings, and the influence of its teaching on leaders of thought and action is brought home by extracts from speeches. Marx and Engels, as is well known, were influenced by their study of the "Origin"; Lenin regarded Darwin as the man who "placed biology, for the first time, on a sound scientific footing". M. Stalin's verdict on Darwin, given in 1938, is of particular interest: "In its development, science can name a good many men who found courage and means to break old, and to create new conceptions and laws, despite all obstacles—despite everything . . . such as Galileo, Darwin and many others". The description which the Prime Minister gave of M. Stalin in Parliament on his recent return from the U.S.S.R. helps us to understand his verdict on Darwin. "Premier Stalin," said Mr. Churchill, "has a deep cool wisdom and a complete absence of illusion of any kind." May not this description be applied to Darwin? He daily searched the face of living Nature in order that he might have no illusions about the manner in which she dealt with living things.

The year 1842 was one of the most eventful in Darwin's life; our colleagues in the U.S.S.R. do well in marking its centenary. In January of that year he finished the manuscript of "Coral Reefs" and sent it off to the printers; in May he corrected the last proofs. His home was then 12 Upper Gower Street, which he entered when he married his cousin, Emma Wedgwood, in January 1839; in 1842 he had entered his thirty-fourth year, was the happy father of two children and had taken into his service Joseph Parslow, who was to remain a member of the family for forty years. Darwin was then in a wretched state of health; his brain was continually overworking itself; he hated London; he called it "smokey", "dirty" and "odious"; he was "house-hunting", hoping to find a peaceful spot in the country within twenty miles of London. It was in the summer of 1842, while on a visit to Maer and to Shrewsbury, that "I allowed myself to speculate on the subject [the origin of species] and drew up some short notes". It is true he had been collecting facts which might throw light on the problem ever since he finished his "Journal" in July 1837; but this pencil sketch, drawn up in the summer of 1842, was his first attempt to apply the theory of natural selection to the explanation of his facts. We may, therefore, regard the year 1842 as marking the birth of the "Origin of Species".

On returning to London, house-hunting was taken up in earnest, the choice finally falling on Down House, in the parish of Downe, Kent, "16 miles from St. Pauls". The purchase had two advantages—rurality and price. Down House, standing on eighteen acres of ground, cost £2,200—£1,000 less than any other place then available at this time. Darwin's income was well over £1,000 per annum, but he feared 'extravagance' above all things; he was a great naturalist, but when answering the queries put to him by his cousin, Francis Galton, in 1873, it was his business ability, not his aptitude for scientific inquiry, to which he gave prominence. Thus it came about that the Darwin household was moved from London to Kent, the flitting taking place on September 14, 1842—another reason for marking the present year as a Darwinian centenary. On entering his new and permanent home he set to work on Part 2 of the "Geological Report of the Voyage of the *Beagle* (Volcanic Islands)" and published a pioneer contribution to glacial action in Britain—"Effects produced by the Ancient Glaciers of Caernarvonshire". He was also busy with plans for improving Down House. Clearly, 1842 was a notable year in the life of Charles Darwin.

Early life at Down House was overcast by a tragedy in the Darwin family. Nine days after arrival Mrs. Darwin was delivered of her third child, which lived only three weeks. There is in the archives of Down House—which, thanks to the public spirit of Sir Buckston Browne, is now preserved as a national memorial—a letter written by Darwin soon after the birth of this child. The letter is addressed to Mrs. Horner, wife of Darwin's geological friend Leonard Horner. Its opening sentences are worthy of quotation because of the light thrown on the opening month in the parish of Downe.

"I am much obliged for your letter and most kind congratulations. . . . We are going on very well and Emma [Mrs. Darwin] is making a quicker recovery owing, I think, to country air, than she has ever done before. Our children are very well and Willy [eldest son, then nearly four years of age] approves

of 'country House' very much. I think the place will suit us very well. We have found moving so expensive that I have not ceased to be thankful that we bought a very cheap house. It is the quietest country I ever lived in."

In this and in other letters of this period, Darwin gives glimpses of his new surroundings—of nightingales, of larks, of fields pink with sainfoin, others white with spread chalk. It may interest our Russian colleagues to know that within these last ten years larks have moved away from the Down House fields, nightingales have almost forsaken its orchard and its sheltering trees, the pink and white fields have taken on other colours, and the sky, so peaceful a century ago, now resounds to the beat of propeller blades—sounds which we counted a nuisance in peace-time but which now, in these days, fall as a comforting music on our ears. But for the courage which makes this music, Down House might well have suffered the sad fate which, in spite of the splendid fighting of the Russians, has overtaken Tolstoy's old home.

To return for a moment to the Darwin exhibition in Moscow. We are glad to note the prominence which Prof. Turov has given to the spirit of humanitarianism which was so deeply ingrained in Darwin's nature—his hatred of cruelty and his horror of slavery. His indictment of slavery is illustrated by a quotation: "What an honour it is for England to be the first of European Nations to completely abolish slavery". This sentence is apparently taken from a letter which Darwin wrote from the Rio Plata and addressed to his elder sister Caroline on May 22, 1833 ("Life and Letters", vol. 1, p. 246). He tells his sister that "it is impossible to see a negro and not feel kindly towards him" and that he is "watching the results of the election", then taking place at home. "What a proud thing for England," he exclaims, "if she is the first European nation which utterly abolishes it [slavery]". Britain was the first, for in that same year Parliament abolished slavery in all British colonies and spent 20 millions of pounds in compensating the slave owners. His hot condemnation of Captain Fitzroy's defence of slavery very nearly brought his career of naturalist on board the *Beagle* to a premature end. Even Sir Charles Lyell, for whom he had an unbounded admiration and affection, was sharply and hotly reprimanded when in 1845 he wrote equivocally of an institution which Darwin felt to be criminal. Even in his books, particularly in the "Descent of Man" (the edition in front of me is Murray's reprint of the second edition, 1913), we see his humanitarianism influencing his scientific verdicts. For example, when discussing the preservation of the weak and unfit by civilized nations, he writes (p. 206): "Nor could we check our sympathy, even at the urging of hard reasoning, without deterioration in the noblest part of our nature". He believed that, in the struggle between our higher and lower impulses, "virtue will be triumphant" (p. 192). After describing the prolonged travail which has divided mankind into so many diverse races, he seems to welcome a movement which would undo Nature's evolutionary scheme. Here is an extract from the chapter which deals with the rise of "Man's Moral Sense" (p. 187):

"As man advances in civilization, and small tribes are united into larger communities, the simplest reason would tell each individual that he ought to extend his social instincts and sympathies to all members of the same nation . . . there is only an artificial barrier to prevent his sympathies extending to the men of all nations and races."

Those who, like Mr. H. G. Wells, advocate 'Universalism' as a remedy from the evils from which we now suffer—particularly the scourge of war—may, on the strength of this passage, claim the support of Charles Darwin. But then, on p. 219, we find this statement: "As man suffers from the same physical evils as the lower animals, he *has no right* to expect an immunity from the evils consequent on the struggle for existence. Had he not been subjected during primeval times to natural selection, assuredly he would never have attained to his present rank". From the context of this passage, one infers that Darwin expected that man's evolutionary struggle was to continue.

There is, I admit, a grave fault in Darwin's presentation of his facts in the "Descent of Man". In the last sentence just quoted we see the emphasis which Darwin places on the agency of natural selection in the evolution of man—an emphasis which has so misled many modern men of letters. Darwin gives prominence to competition, selection, survival, extermination, to all man's antagonistic qualities; but when we look into the contents of his longest three chapters—3, 4 and 5—we find they are devoted to the evolution of man's co-operative mentality—the evolution of those instinctive and emotional reactions which bind men into family groups, into independent tribes—which are but extended families, and sovereign nations—which are but overgrown tribes. In the evolution of man co-operation has played quite as important a part as antagonism. Darwin assumed that men—even in their prehuman state—lived in social groups, and all that has been learned in the last seventy years justifies this assumption; and that the instinctive and emotional reactions which bound them into isolated groups had been developed from those more primitive ties which unite members of a human family.

The main struggle in the evolution of man, therefore, was between tribe and tribe, and it was this competitive aspect of the problem which seized Darwin's attention. I could cite many passages to prove that he was equally alive to the co-operative machinery which was at work inside each evolving tribe. For example (p. 203), "a high standard of morality gives but a slight or no advantage to each individual man and his children over other men of the same tribe, yet an increase in the number of well-endowed men and an advancement in the standard of morality will certainly give an immense advantage to one tribe over another". Without morality there could be no co-operation of members of a tribe. In reply to a criticism which the late Lord Morley passed on the "Descent of Man" Darwin gave this answer: "I have endeavoured to show how the struggle for existence between tribe and tribe depends on an advance in the moral and intellectual qualities of the members and not merely on their capacity of obtaining food" ("More Letters", vol. 1, p. 326). In brief, if we could have looked inside the developing brain of an early tribesman we should have found a dual mechanism at work, one giving rise to mental qualities which induced co-operation in members of a tribal team and another which impelled these members to maintain their team intact at all costs.

Light is thrown on the difficult problem of combining co-operation with competition in a corporate

body (for a primitive tribe is a close corporation of interbreeding individuals) by what is taking place in the modern business world. We may take our illustration from our banking businesses. Ever since Darwin's day there has been taking place, just as happened in recent millennia in the human world, a tendency to the creation of an ever-increasing size of the evolutionary units; local banks have been amalgamated, and local amalgamations have been swallowed by central concerns, so that now only a limited number of great competing units survive, which units we may compare to the great nations of to-day. These large corporations, being managed by self-electing directorates, are run, as a recent writer points out (*The Times*, "Private Enterprise", September 18 and 19, 1942), for the benefit not of the whole British community but for a section of it. The problem is how the whole community can be benefited and yet be free from the evils, or risks, of monopoly.

Nature had, and has, to face the same problem in the evolution of mankind. The directorate she instituted for her purpose is that combination of qualities we call 'human nature', in which co-operative and competitive inborn or instinctive tendencies work for the good of the community or tribe as a whole. To quote Darwin once more (p. 190), "The social instincts . . . no doubt were acquired by man, as by the lower animals for the good of the community".

THE EXPLOITATION OF MINERALS IN RELATION TO NATIONAL AND WORLD PLANNING*

By DR. L. DUDLEY STAMP

ALL minerals are won by what used to be called 'robber economy'. Man has no control over the location of minerals: his efforts are directed towards the discovery and subsequent winning of deposits the position of which is dependent upon the geological structure of the earth, or towards the utilization of deposits not previously regarded as 'economic'. Once any given deposit is exhausted it is not replenished.

Thus the social and economic consequences of the extractive industries are entirely different from those which result from industries connected with either the animal or vegetable kingdoms. In those cases, provided adequate care is taken, Nature replenishes the stores year by year and the dependent industries are afforded a marked degree of permanence. By the limited nature of the resources on which they depend, mineral industries, whether merely extraction or processing, or secondary industries based thereon, are essentially impermanent.

It is of considerable importance to distinguish between two groups of economic minerals. In the first place, there are those which occur in limited supply and where the object of mining is to remove *all*, or as much as is economically feasible, of the mineral. Into this category come oil, coal, iron ore (at least above a certain metal content), and most metalliferous ores. In the second place, there are those minerals which occur in such abundance that only parts of the available deposits are ever likely to be worked. Into this category come limestone (including chalk) for lime and cement, clay for bricks and tiles, slate, building-stones, road metal, sand and gravel.

In the international planning of mineral exploitation it is the first group which is concerned: the rocks and minerals of the second group are of the greatest importance, but nationally rather than internationally. In the minerals of the first group there is little choice in the siting of the works; in the minerals of the second group it is possible to plan the actual areas of working to a considerable extent—they are usually dictated primarily on economic grounds, especially in relation to transport costs, but where necessary may be planned in accordance with requirements of the national planning or the location of industry, the conservation of agricultural land, the preservation of amenities and other relevant factors.

Restricting attention to the minerals of the first group, those of which the object is to remove the whole or as much as possible, a definite cycle is associated with the working. This is, briefly, exploration, exploitation and exhaustion. With *exploration* and the early stages of exploitation comes a very rapid development, an influx of population, a spate of building and often of extravagant expenditure—indeed all the conditions associated with a 'mining boom' whether it be a gold rush, an oil boom, or simply the development of a new coalfield. The period of relatively steady *exploitation* may be short (as in the case of alluvial gold or tin) or it may be long—even running into a century or more (as in the case of a coalfield). If it is long, then social and economic conditions become stabilized, substantial towns are built and the whole community may go so far as to forget that its existence is primarily dependent on the exploitation of a mineral deposit. This is the position reached in many of the older coalfields of Britain. The period of *exhaustion* or approaching exhaustion is one of serious and inevitable maladjustments often resulting in much human suffering and misery, and which calls for careful thought and action—it cannot be left to right itself.

Thus the recognition of the right of the nations of the world to share the world's mineral resources carries with it the obligation of those nations to accept responsibility and to share the burden of whatever social and economic readjustments may be needed. There is, in other words, an obligation to safeguard the interests of human beings both during and after the exploitation of the minerals.

Most of the problems which arise, and some of the readjustments, can be illustrated, though on a small scale, in the British Isles.

(*a*) Tin has been won in Cornwall and the south-west since pre-Roman times. Exploitation reached its peak some seventy years ago and resulted in a large number of mines with their conspicuous pithead gear widely scattered over the wilder parts of the county. At least two not inconsiderable towns, Camborne and Redruth, grew up dependent primarily on mining. To-day most of the deposits are sufficiently near exhaustion that in pre-war years their exploitation had become uneconomic. As a mine approaches the later stage of its career, there is little money left after running costs have been met and, when the mine fails, none at all to remove the old gear and buildings, which thus become unsightly ruins marring

* Paper read at the Conference on Mineral Resources and the Atlantic Charter arranged by the Division for the Social and International Relations of Science of the British Association on July 25.

the countryside. In the case of the Cornish tin mines, much of the skill, experience and capital released from local mines was transferred abroad—many Malayan companies are offshoots of Cornish parents and are often staffed by Cornish miners. Camborne and Redruth came to depend on foreign investments—one solution, perhaps a rare one, of this difficult problem.

(*b*) Lead was won by the Romans and at this moment is being worked again in Cumbria and elsewhere. The position is much as with tin, except that there is here an additional complication: that of noxious effluents and poisonous fumes from smelting. The first promise often to destroy freshwater life, including valuable fisheries; the second may ruin agriculture as well as natural vegetation for miles round. The aftermath is terrible. The same is true of the extraction of salt, gypsum, and the associated heavy chemical industries.

(*c*) Iron ore. The once flourishing iron industry of the Weald has gone, leaving little or no trace; the iron industry of the South Wales coalfield is more recent and has left behind a solid core, in peace-time conditions at least, of unemployment. In the Black Country, the evils have been mitigated by the switch over to other industries. The latest phase of maladjustment in the iron industry is seen in Northamptonshire, where thousands of acres of good agricultural land are being left, after removal of the ore, a stony desert of steep ridges and valleys useless to man and beast and affording little hope even for useful vegetation or afforestation. Yet a limited expenditure, with the aid of modern levelling machinery of the type now being used on aerodromes, could restore this land to usefulness.

(*d*) Slate quarries, chalk quarries, and other scattered surface workings, including those for gravel and sand, raise especially questions of amenity and the need for regulation, including definite directions towards the location of industry, in national planning.

(*e*) Coalfields afford examples of the problems raised by mineral working at their most difficult. A coalfield develops slowly, and its development gives rise to such permanent towns and villages that the subsequent problems of readjustment are extremely difficult. So rooted are the human beings that the solution of the problem has tended to be, not the 'scrapping' of the settlements—which is the logical course—and the removal of the people, but the deliberate effort to bring industry of new types to the pool of labour thus available.

These examples, drawn from Britain, are sufficient to illustrate the far-reaching character of the human and economic problems raised by the apparently simple proposition of sharing the world's mineral resources. It would seem that three principles emerge:

(1) Mineral exploitation inevitably results in a need for restoration, whether it be of land or of the social structure of the community.

(2) This restoration should be obligatory on those, whether nations or individuals, who derive benefit from the working of the minerals.

(3) In the latter stages of mineral exploitation there is never a surplus of money, and therefore there should be some provision, comparable to an amortization insurance, made when the industry is flourishing, for use in the later stages for the work of restoration and rehabilitation.

A STUDY OF ACCIDENTS

EMERGENCY REPORT No. 3 of the Industrial Health Research Board* is concerned with the problem of accidents, always important but still more so in war-time, when many circumstances combine to increase the risk of accidents. There is a tendency on the part of many people to accept accidents as inevitable happenings; one has only to recall the indifference to road accidents before the War to realize this. For some time now, efforts have been made to render the environment in which the industrial worker spends his working time safer; the legal aspect is embodied in the Factories Act and the Ministry of Labour Regulations, while advice is given by factory inspectors and the Royal Society for the Prevention of Accidents.

The report on accidents falls into two parts: the first part concerns itself with the general factors likely to affect all workers in different degrees; the second part deals with the individual differences which result in reactions which are not uniform.

General Factors affecting the Incidence of Accidents

(1) *Hours of work.* During the War of 1914–18 investigations showed that unduly long hours led to an increase in the accident-rate, and there is evidence that fatigue was largely responsible. In war-time longer working hours are necessary, but there comes a point past which it is no longer profitable to let people work. Fatigue not only reduces the speed and accuracy of muscular movements, but also affects mental alertness.

(2) *Heating and ventilation.* The number of cuts and minor accidents increases with temperatures much above or below the range of 65–69° F. Where processes generate much radiant heat the worker should be protected. Adequate ventilation should not be regarded merely as a side issue.

(3) *Lighting.* Lighting so inadequate that the worker cannot see his work effectively is a contributory cause of accidents. Too great a variation in lighting must also be avoided. Natural lighting, that is, daylight, is ideal when there is enough of it.

(4) *Speed.* Speed of production is a frequent cause of accidents, and since it is necessary in modern industry, care must be taken that machines are not moving too quickly, nor workers put on to speeds to which they cannot adjust themselves.

(5) *Inexperience and age.* Both these conditions are related to accidents, but are independent. People, whatever may be their age, if inexperienced at industrial work, are known to have a higher accident-rate than a similar group of experienced workers. Also young people, whether experienced or not, are more liable to have accidents than older people, partly because they are less responsible and partly because they have less control over their muscles. Therefore there should be adequate training for beginners, whether young or not, and adequate supervision for the young.

(6) *Fitness for the work.* Quite apart from physical unfitness a worker may be mentally ill-adapted to his work. There is evidence that workers of high mental ability, if employed on repetitive work demanding little thought, become bored, which state

* The Personal Factor in Accidents. Emergency Report No. 3. Industrial Health Research Board. 1942. 4*d*. net.

leads to a variable output, fatigue and therefore to a high accident rate. This question of fitness is connected with that of vocational selection, to which far too little attention is paid.

(7) *Attitude of management and workers.* Both management and the workers have a part to play in accident prevention. If the former takes up the attitude that accident prevention is not an essential part of production, then there is little likelihood of a serious reduction even though lip service be paid to safety committees.

On the other hand, even proficient workers often neglect to take safety precautions because each works on the very human principle of "It can't happen to me". Although a worker may be very proficient, that does not connote an immunity to accidents; a temporary lack of thought due perhaps to slight physical ill-health or mental pre-occupation may have serious consequences. Also the expert workers have a responsibility for the less expert, since these, particularly if young, tend to imitate the former. Care is not synonymous with fear.

Accident-proneness

When all the above causes have been considered there yet remains a factor that has been dimly recognized but until recently ignored. Everyday experience or the examination of accident statistics makes it clear that, given similar conditions of environment, or of the other factors already mentioned, there are people who have more accidents than their fellows. This difference is attributed by some to chance or to the effect of a first accident on a person's liability to another. Scientific analysis has, however, shown the special importance of a condition which is now known as 'accident-proneness'.

Statistical workers were the first to study systematically the unequal distribution of accidents among people exposed to the same risks. It is obvious that the accidents studied have been chiefly minor ones, since fortunately major accidents are not sufficiently frequent during a reasonable period of observation. Where, however, it has been possible to relate major accidents with minor ones, it has been found that those who had many of the latter also had an undue number of the former. Efforts made, therefore, to prevent people specially susceptible to accidents from dangerous work will protect them both from major and minor accidents.

Accident-proneness must be distinguished from accident liability. Liability to accident is largely determined by the degree of risk to which a person is exposed. Differing environmental conditions alter accident liability quite apart from any personal characteristics predisposing towards accidents. Although general liability differs from one group of workers to another according to the nature of their occupation and working conditions, yet in any one group of workers, however great or small may be the risk, some have more than their fair share of the accidents.

Psychological investigations have shown that those with an unduly high accident rate can be partly differentiated on the basis of measurable individual reactions.

So far only one factor of this accident-proneness has been identified and measured; others may eventually be measured; some may never be. For nearly twenty years investigators have been experimenting to find some test or group of tests to serve as a means of predicting this minority. Tests used to measure the capacity to respond accurately within a controlled time interval to various sensory stimuli have given reliable results in the case of skilled workers. In skilled occupations those who do well in the tests have been found to have, not only a lower accident rate, but also a higher rate of proficiency than those who do badly. Unfortunately, the tests cannot select all the accident-prone, though they do select a fair proportion.

There is no question of not employing the accident-prone; they are perfectly normal people who can be usefully employed in most occupations, but if employed in an occupation with a high accident liability they are a danger to themselves and to others.

Accident liability is the sum total of all the factors determining accident incidence; accident-proneness refers solely to the individual factors affecting it.

There are two ways of partially predicting the accident-prone. One is by finding the number of accidents sustained by each individual in a working group during a previous period of exposure; the other by using certain tests. The most effective way is to combine both methods. This procedure has been shown in both transport and industrial accidents to reduce the subsequent accident rate to an appreciable extent.

It must be emphasized that if proper use is to be made of our knowledge it is most important that adequate records should be kept. Quite apart from the humanitarian aspect of accident prevention, a reduction in the working time lost would have a beneficial effect on production. MAY SMITH.

OBITUARIES

Dr. S. G. Barker, O.B.E.

THE world of fibres in its industrial development lost an outstanding personality and one of its greatest authorities in the sudden death, on August 28 last, of Dr. Sydney George Barker, scientific adviser to the Indian Jute Mills Association since 1934. Prior to taking up this appointment, the late Dr. Barker had been director of the Wool Industries Research Association, and most of his scientific and business life during the last twenty years was occupied in conducting and controlling investigations into the sources, preparation, properties and commercial utilization of the scarcer—principally hard—fibres.

Dr. Barker was born in York in 1887, of typical Yorkshire Nonconformist stock, and, throughout his life, he displayed all the sterling qualities and rugged honesty of character and purpose of his origin and upbringing. His early education in York was followed by study—principally of physics and mathematics—at the Imperial College of Science and Technology, London, and at the University of Berlin. He was one of the early holders of the research scholarships, tenable in German universities, instituted as a result of the efforts of the late King Edward VII to bring about a closer understanding between the two countries. Academically, although he won a number of distinctions, his progress was marked more by the steady and sustained effort of his acutely critical and inquiring mind than by any brilliant scholastic achievements.

In 1915, Dr. Barker began that long connexion with India and Indian industries which was to continue until the close of his life. He became director

of industries to the Government of Travancore and produced for that Government a monumental "Survey" of the industrial possibilities of the province.

His sound judgment and acute perception of essentials in technological and industrial matters led to many calls upon him by various Indian Provincial Governments, and his work for these is embodied in more than fifty bulletins and papers on chemical and allied industries for State Departments and other official bodies. Dr. Barker, with his wife, whom he had married in 1915 before he sailed from England, threw himself wholeheartedly into all the activities of his surroundings, and served for some time as an officer of one of the local regiments. He was, for a period, vice-principal of the Maharajah's College at Trivandrum (University of Madras) and took an active part in its development.

In 1921, a breakdown in health forced Barker to return to England, and he began to suffer from the deafness which, in later years, became a severe handicap to all his activities. On his arrival in this country, he served for a time as principal assistant in the Research Department of Woolwich Arsenal. In 1926, he took up what was to be one of the great successes of his career—the directorship of the Wool Industries Research Association in Leeds. His brilliant work in this post, his devising of new processes and improvement in old ones, his invention of instruments and methods of testing, his work in organizing and compacting manufacture, resulted in notable progress in this fundamental industry, and established the Association as an indispensable factor in the development of sheep breeding and rearing and the improvement of the quality of the wool fibre throughout the British Empire. During this period also he worked in the closest association with and for the (now defunct) Empire Marketing Board, for which he examined many possibilities in the utilization of various fibres produced in different parts of the Empire. For this work he was awarded the O.B.E.

In 1934 he was invited to act as scientific adviser to the Indian Jute Mills Association, a position which he held to the time of his death. He visited India in 1935 and again in 1938 to establish and extend laboratories and supervise research and development schemes on behalf of the jute industry, and, on his return, he set up similar laboratories in Great Britain, supplementing and controlling the work in Calcutta. In this industry, as in the case of wool, he was responsible for rapid and useful progress, until the outbreak of war gave an already busy life still more work to be undertaken. He was appointed to various official advisory posts chiefly connected with the use of textiles and fibres in the war effort, and he was never lacking in suggestion and in the organization of inquiry whenever problems were encountered in which these products could be of use. His increased work caused him to suffer still more from deafness and from general ill-health until, in the course of completing an official journey to the north, he collapsed and shortly thereafter passed away.

Dr. Barker was a prodigious worker with an extraordinary memory for unusual items of information likely to be of use in his researches, and an energetic, cheerful and loyal colleague. He covered a wider range of scientific and industrial investigation during his life than is given to most men to achieve, and his success in what he undertook was recognized by the many honours conferred upon him and by membership of a large number of scientific and technical societies and committees, both at home and abroad. His output of written contributions to knowledge includes two monumental works on "Wool", and treatises on "Coir", "Sisal" and "Jute", in all of which fibres he was the world's foremost authority. Besides these works, he has to his name more than two hundred shorter papers, brochures and reviews of a less comprehensive character.

His death at this time, when his knowledge and experience were of so much value to the national war effort, is a grievous loss, and the thought that his passing was due solely to the intensity of his striving to help, is a tragedy. He leaves a widow, but no family.

Prof. Ludwig Aschoff

PROF. LUDWIG ASCHOFF, the eminent German pathologist and medical historian, whose death at Freiburg im Breisgau was recently announced, was born in Berlin on January 10, 1866. He received his medical education at Bonn, Strassburg and Berlin and qualified at Bonn in 1889. After serving as assistant in Recklinghausen's Pathological Institute during 1891–1893 and at the pathological institute at Göttingen from 1893 until 1903, he was appointed professor of morbid anatomy at Marburg and at Freiburg im Breisgau three years later. His principal work was a system of morbid anatomy, of which he was editor and to which he contributed the articles on disorders of the circulation, inflammation, the heart and pericardium, urinary system, female sexual apparatus, and the digestive system. The eighth edition appeared in 1936. His other publications included works on appendicitis, cholelithiasis, thrombosis, scurvy, and a history of medicine in tabular form, of which the third edition in collaboration with Prof. Paul Diepgen was published in 1936. He was also editor of *Beiträge zur pathologischen Anatomie und zur allgemeinen Pathologie* and co-editor of *Veröffentlichungen aus der (Kriegs-) Gewerbe- und Konstitutionspathologie*. Aschoff's name is attached to an organ in the paradidymis and paroophoron, rheumatic nodules in the myocardium and lungs and with that of Tawara to the atrioventricular node in the heart.

J. D. ROLLESTON.

WE regret to announce the following deaths:

Mr. F. W. Clifford, librarian of the Chemical Society, on September 21.

Prof. E. Fawcett, emeritus professor of anatomy in the University of Bristol, on September 22, aged seventy-five.

Prof. P. A. Hillhouse, professor of naval architecture in the University of Glasgow since 1921, on September 28, aged seventy-three.

Prof. W. J. G. Land, emeritus professor of botany in the University of Chicago, known for his work on tropical plants, on August 1, aged seventy-six.

Dr. Henry G. Knight, chief of the Bureau of Chemistry and Soils of the U.S. Department of Agriculture, on July 13, aged sixty-three.

Prof. David Waterston, Bute professor of anatomy in the University of St. Andrews, on September 4, aged seventy-one.

Prof. H. D. Wright, professor of bacteriology in the University of Liverpool and City bacteriologist to the Liverpool Corporation, on September 9, aged fifty-one.

NEWS and VIEWS

The Church as a Social Force

THE mass meeting held at the Albert Hall, London, on September 26, was convincing evidence of the keen interest that is shown in the Church as a social force, especially in view of the fact that many times more applications for tickets were made than the huge hall could accommodate. The Archbishops of Canterbury and York and the Lord Privy Seal were supported by ambassadors, bishops and representatives of various religious bodies, commerce and industry at this meeting, which was arranged and organized by the Industrial Christian Fellowship as a sequel to the Malvern Conference of 1941. The Archbishop of Canterbury, who has shown a keen interest in, and done splendid work for, the social life of the country, and has already made valuable suggestions towards social reconstruction, emphasized that the Church has both a right and a duty towards declaring and supporting those principles which should govern the order of society. This is, after all, the natural sequence to the universally recognized duty of the Church to lay down principles for the conduct of individuals, the only difference being that the Church should now extend her influence to society, that is, groups of individuals. In the past, by ignoring society, fellowship has either not been fostered or has been broken where it existed, thus resulting in gross disparity of wealth and poverty, lack of leisure and so forth. The predominant motive guiding enterprise in the past has been that of profit. In the future, this must be put in its proper place, for it is not only an expression of selfishness but is also clearly not in the general interest. For the promotion of the general welfare there are two special problems, namely, land and money. The traditional Christian principle still holds good, that the right of property was a right of stewardship—never exclusive use. Therefore the Uthwatt Report, which aims at the combination of the advantage of public ownership and ultimate control with private initiative, is to be welcomed. So far as money is concerned, banks, now more or less amalgamated, should be limited in power to the amount deposited by their clients, while the issue of new credit should be a function of public authority.

The Archbishop of York spoke on housing and planning, stressing that a gigantic urban housing programme will have to be organized as soon as hostilities cease. The problem, however, already exists, both in town and country, and if there is any hope of demobilized men settling down to life in the country then steps should be taken to provide houses in rural districts even during the War. But housing must be planned. In this connexion we have as an example the disastrous mistakes made after the War of 1914–18. Further growth of already overgrown towns must be discouraged, while the decentralization and dispersal of new industries must be encouraged. New towns must be real communities centred round church, school and guildhall. Agricultural land and national parks must be earmarked, and, if necessary, private interests overruled.

Sir Stafford Cripps emphasized the recent enormous growth of the social conscience of the churches. So now it is for the Church to provide the moral force and the driving power for social and economic developments. The Church might well adopt as its Christian objectives the five "simple desires of the people of America" as expressed by President Roosevelt, namely: equality of opportunity; jobs for those who can work; security; ending of privileges for the few; preservation of civil liberties for all. If the Church agrees that these objectives are the embodiment of fundamental Christian principles, then nothing should stand in the way of their realization. Sir Stafford suggested that perhaps the Church herself is standing in the way; for example, if privilege is to be ended, then the Church herself must be prepared to give up her privileges with the rest, not excluding the privilege of endowment and of establishment.

The Bishop of Bristol gave an account of the growth and activities of the Industrial Christian Fellowship, and Miss Knight-Bruce spoke on "Education in the New Order". The substance of all the addresses given at the meeting is contained in a pamphlet entitled "The Church Looks Forward", published by the Industrial Christian Fellowship, 1 Broadway, Westminster, S.W.1, price 6*d*. It is hoped to discuss this pamphlet at greater length in NATURE shortly.

Natural Sources of Rubber

AN interesting note on possible West African sources of rubber is contributed to *Farm and Forest* (3, No. 2, June 1942) by J. H. Mackay, the general editor, who is on the staff of the Forest Department, Nigeria. Latexes vary in the proportion of resin and caoutchouc they contain, the more resinous providing the bird limes of the West African native. 'Ate', the coagulated latex of the vine *Carpodinus hirsuta*, has been in demand since the outbreak of war for trapping moth pests of stored cocoa, but it was formerly exported as a 'paste' rubber. The latex of *Ficus platyphylla* yields the Niger gutta of commerce; for this a former demand for use in the manufacture of chewing gum shows signs of reviving. It contains some 13 per cent caoutchouc. *Funtumia elastica* is the only indigenous rubber yielding tree; in 1896 some three thousand tons of rubber was exported from it but the yield fell owing to ruthless tapping.

Various lianes of the same family (Apocynaceæ) also yield excellent rubber. In cultivation the yield of rubber from Funtumia was only about 60 lb. of dry rubber to the acre compared with several hundred pounds from Hevea. *Hevea brasiliensis* was introduced into Lagos in 1894 and in 1938 exports from the Cameroons and Nigeria exceeded three thousand tons. The Benin Sands have proved particularly suitable for its cultivation. A recent publication by Muriel E. Whalley (*Nat. Res. Council*, No. 1071, Ottawa, 1942) may be of general use in connexion with the present widespread survey of possible natural sources of rubber. It surveys the various methods of extracting rubber from plants as recorded in the literature.

Control of Lantana in Madras

THE control of Lantana (*Lantana aculeata* = *L. camara*) and the spike disease of sandal have been occupying the attention of the forest officer in parts of the Madras Presidency for half a century. The Lantana was first introduced into India from Ceylon (it is a native of Central America) in 1833 as a garden plant. Its spread through peninsular India was almost meteoric and it has become naturalized throughout the whole country. Its importance as a forest pest was first voiced in 1893, and since that

period many attempts, mostly abortive, have been made to deal with it. From 1934 research work with chemical methods has been carried out. These investigations were at first published in the *Indian Forester* but are now reproduced with the figures in "The Control of Lantana by a Sodium Chlorate Spray", by A. L. Griffith, sylviculturist, Forest Research Institute, Dehra Dun (*For. Bull.*, No. 106, Sylvicultural Series, Govt. of India Press, Calcutta, 1941). The importance of the investigations will be evident by the rapidity of the spread of the pest. In north Salem, where the work has been undertaken, it is recorded that in the north Salem forest division in 1917 there were 4,800 acres of Lantana. In 1935 the area had increased to 56,000 acres, while in 1941 it is stated that a very recent estimate put the area at just over 100,000 acres. This was the area in Government Reserved Forest only in the district. The density of the Lantana is often as much as 5,000 to 10,000 stems per acre. The experience gained so far shows that successful control by spraying with sodium chlorate is possible at a cost roughly of £10 per acre and that such a spray has no toxic effect on subsequent rejuvenation on the area. The results of this piece of research appear to be important. The Bulletin gives full details of the methods of applying the spray.

Psychiatry and Alcoholism

IN a recent paper (*Virginia Med. Monthly*, **69**, 417; 1942), Dr. Merrill Moore, associate in psychiatry at the Harvard Medical School and director of research at the Washington Hospital for the Treatment and Prevention of Alcoholism, declares that the three greatest public health problems in the United States to-day are tuberculosis, syphilis and alcoholism. Although the first two have received continuous attention from the medical profession during the last twenty years, alcoholism has not yet been completely accepted as a medical problem. According to Dr. Moore, acute or chronic alcoholism seems to result partly from the psychological inadequacy of the individual, and is therefore most likely to be found in persons who in childhood have been over-protected, too strongly dominated or pampered by over-solicitous parents. Prolonged drinking usually results in some form of neuropsychiatric disorder, which may be an avitaminosis, such as alcoholic neuritis or pellagra caused by faulty diet, or there may be a frank alcoholic psychosis such as Korsakow's syndrome.

The frequent association of mental disease with alcoholism is shown by the fact that 60 per cent of all patients admitted to Massachusetts mental hospitals in the last twenty-five years gave a history of alcoholism. The high cost of alcoholism to the taxpayer is due to the fact that most alcoholic men and women are cared for in State or municipal hospitals to which they make no payment, and relief is required for the families and dependants of alcoholics whose income and earning power have been lost. Moreover, the cost is increased by the maintenance of courts for the distribution of drunkards in penal institutions. Dr. Moore maintains that there is a great need for the establishment of special clinics and hospital facilities for the treatment of alcoholics. At present they are not welcomed for treatment unless they can afford the necessarily high cost of private institutions, nor are they accepted at most State institutions unless they are suffering from alcoholic psychoses or equally severe mental illnesses in which alcoholism plays a secondary part.

The Journey of the Sun

RALF E. WILSON discusses the motion of the sun in the Galaxy in Leaflet No. 161 (July, 1942) issued by the Astronomical Society of the Pacific. Before 1900, all determinations of the apex of the sun's motion were based upon proper motions, that is, motions at right angles to the line joining the star to the earth; and many of these were poorly determined and affected by appreciable systematic errors. About 1910, previous determinations were superseded by the results of two major investigations. The proper motions of about 6,000 stars had been determined on a standard system, and the observations started early in the century had produced 1,200 radial velocities. The latter gave an apex about 9° south of that derived from proper motions, and part of the discrepancy was attributed to the fact that radial velocities referred almost entirely to stars brighter than magnitude 5·5, the proper motions including essentially all stars brighter than magnitude 6 and many fainter ones. As radial velocities became available for the fainter stars the discordance increased, and in 1925 was largely removed by the discovery of systematic errors in the proper motions. The most recent investigations show that the motion of the sun, with respect to the naked-eye stars, is towards a point at right ascension 18h. and declination + 30°, near o Herculis, with a speed of 12 miles a second. The actual direction in which the sun is travelling in its galactic orbit lies about 40° north and east of the position just given, and the speed is about 180 miles a second. The low-velocity stars, with reference to which the sun's speed is 12 miles a second, are members of the same galactic subsystem as the sun, and are also subject to the same amount of rotation. The rotation of the sun around the centre of the galaxy is completed in about 200 million years.

New Companion to μ Draconis

DR. K. AA. STRAND, of Sproul Observatory, has reported the existence of a third companion in the double-star system of μ Draconis (*Sky and Telescope*, August). It is known only by the regular fluctuations from the expected motion of the two visible components, observations having extended over three years. The brighter components have a period of revolution of about 1,500 years and the new companion revolves around one of them at a distance of about three astronomical units. It is a dwarf star with a mass half that of the sun.

Electricity in the Annealing of Glass

A PAPER by E. S. Morris on the application of electricity to the annealing of glass bottles and containers (*J. Inst. Elec. Eng.*, **89**, Pt. 2, No. 10; Aug., 1942) first explains the nature and primary importance of annealing processes as applied to commercial glassware, with particular reference to bottles and containers. Development stages, from heated brick arches to portable and continuous lehrs, are then described in the section on mechanical improvements. The application of controlled heat to the fused and moulded product is shown through the transition stages of coal, producer-gas and oil firing, to complete electrification of annealing lehrs. Insulation factors and methods; heat conservation and re-application; cooling graduations; economic and product quality considerations in favouring the application of electricity as a power and heating element, are all made

subjects for explanatory data. A brief account is given of tumbler-edge glazing and enamelling, which involve the processing of pre-annealed cold ware.

An A.C. and D.C. Peak-Factor Meter

E. H. W. BANNER (*J. Inst. Elec. Eng.*, **89**, Pt. 2, No. 10; Aug., 1942) describes an electrostatic voltmeter type of instrument connected to give readings proportional to the r.m.s. voltage and designed to give a rapid indication of the peak factor (peak/r.m.s.). When the reading is steady, operation of a press-key introduces a rectifier into the circuit for peak voltage, and in the case of alternating current also introduces by a tapping $1/\sqrt{2}$ times the applied voltage, so that the voltage applied to the voltmeter is the same as for the r.m.s. position if the wave form is sinusoidal. In this case no pointer movement occurs and the scale may be calibrated as for 1·41 peak factor. Other peak factors may be added directly from the voltage scale. The application to rectified and smoothed direct current is also proposed, 'pure' direct current having a peak factor of unity. It is further proposed that 'impure' direct current may be specified by its peak factor rather than by the 'ripple', as no standard is laid down for the term 'ripple'. Conditions of use are considered and possible errors examined. The instrument is inherently accurate, as the voltmeter scale is used for both peak and r.m.s. readings and scale errors thus tend to cancel out. Tests have borne out the theoretical considerations.

General Health and Dental Hygiene in Mexico

IN a recent paper (*Bol. Of. San. Panamericana*, **21**, 643; 1942) read before the Third Medico-Dental Convention at Mexico City, Dr. Miguel E. Bustamante discusses the development of public health dentistry in Mexico. At the present time the Department of Sanitary Specialization, which is maintained jointly by the Public Health Department and the International Health Division of the Rockefeller Foundation, provides free dental care by the supply of full-time dentists. There are dental services connected with the school health services in forty cities, and in the Federal District dental clinics in dispensaries of the Ministry of Public Assistance are open to adults. In 1940 there were 31 dentists working exclusively for the co-ordinated services of the various States, and the Public Health Welfare and Education Departments employ an even larger number in the Federal District. Within recent years dentists have collaborated with doctors, sanitary engineers, nurses and laboratory workers in the task of preventive medicine instead of confining themselves to the treatment of patients already suffering from infections of the mouth. The increased interest taken in dental hygiene is shown by the attention given to the patient's previous diseases, the chemical composition of his drinking water, the kind of food he eats and, in the case of children, the health condition of the parents, and the diet of the child from an early age. Prenatal hygiene followed by correct child nutrition and prevention of contagious diseases such as measles, whooping-cough and smallpox, greatly contribute to dental hygiene.

Radiotherapy in Peru

THE July issue of the *Boletín de la Oficina Sanitaria Panamericana* gives an account of the Peruvian National Institute of Radiotherapy which was opened at Lima on September 19, 1940. It is devoted to the study and prevention of cancer and to the promotion of specialized university training on the subject. It will be provided with all the modern equipment for the early treatment of cancer and will supervise educational and social work directed against this disease. The institute occupies a modern building containing five stories, and is equipped with apparatus for X-ray diagnosis, X-ray therapy and general radiotherapy, as well as with a general physiotherapy department. There is a laboratory for hæmatology, serology and histopathology, as well as clinics for general medicine, surgery, gynæcology, urology, gastro-enterology, otorhinolaryngology, stomatology, etc. A hospital contains a hundred beds for free and paying patients, and the number of beds can be increased if necessary. One floor has been reserved for the technical staff and nurses. By the end of June 1941 the institute had treated 575 persons.

Recent Earthquake Records

ACCORDING to preliminary bulletins just received from the Central Station of the Jesuit Seismological Association at St. Louis, U.S.A. (director, J. B. Macelwane, *S.J.*), fifteen strong earthquakes were registered on the seismograms during the first quarter of 1942. Further, two strong earthquakes were registered during the early part of April. On April 8, from the readings of seismograms obtained at twelve observatories, an earthquake with initial time near 15h. 40m. 10s. U.T. had its approximate epicentre at lat. 11° N., long. 118·8° E., which is in the China Sea, west of Bacuit (Palawan Island), north of Borneo. On April 11 the seismograms from eight observatories apparently indicated two deep-focus earthquakes in close succession and having nearby epicentres. The first had initial time near 01h. 25m. 23s. U.T. and epicentre near lat. 15·2° N., long. 91·5° W., with depth of focus about 230 km. The epicentres of the earthquakes were thus very close to the volcano Tajuulcom in Guatemala (Central America).

Use of Specialist Journals

THE council of the Association of Special Libraries and Information Bureaux (ASLIB), 31 Museum Street, London, W.C.1, is offering to give advice on the disposal of specialist scientific and other journals. Many important libraries, not only in Great Britain but also in other countries, have been damaged or destroyed by enemy action, and in consequence it has become increasingly difficult to obtain back numbers of specialist periodicals for consultation; current issues have also gone astray from time to time through postal and similar difficulties. Yet in many cases, private individuals receive copies of scientific papers which they do not wish to keep for more than a limited period. The Association therefore suggests that, as a first step, members of professional and learned societies should return unwanted copies of papers they receive as part of their membership to their societies. The societies would in this way be able to build up stocks of their own publications against the time when damaged libraries will be endeavouring to build up their stocks.

ERRATUM. The last paragraph in the News and Views columns of NATURE of September 26 (p. 372) referred to the opening meeting of the new session of the Institute of Fuel, not the Iron and Steel Institute as printed.

LETTERS TO THE EDITORS

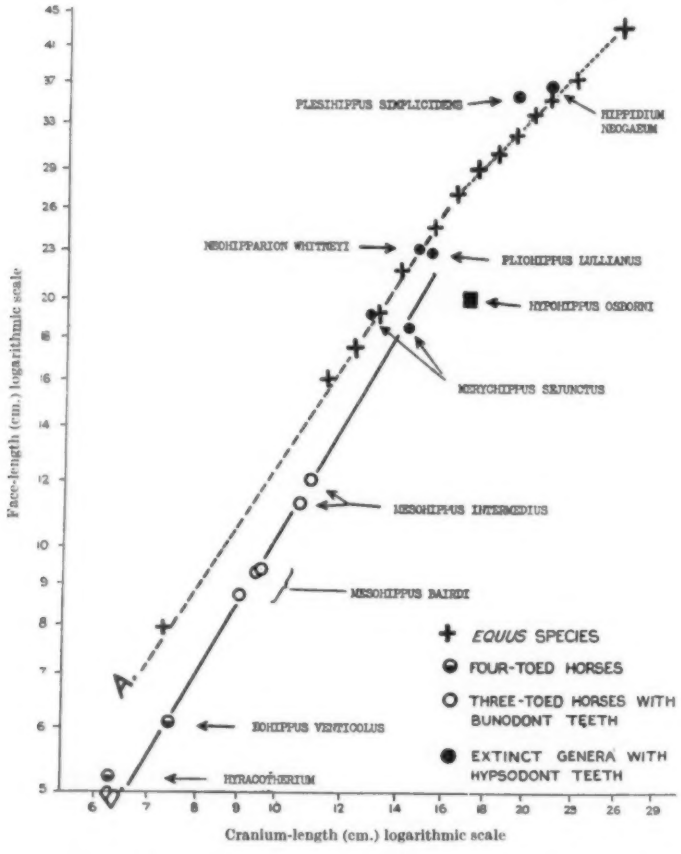
The Editors do not hold themselves responsible for opinions expressed by their correspondents. No notice is taken of anonymous communications.

Evolution in the Horse's Skull

ROBB[1] claimed that evolutionary changes in the horse's facial index (face-length/cranium-length) could be explained on the basis of a single law of relative growth of the face against the cranium, acting through mutations affecting solely an increase in general size. His argument is supported by a graph of face-length plotted against total skull-length for a number of fossil and modern horses, which on superficial examination seems to show that the two sets of points for phylogenetic and ontogenetic growth fall on a common straight line. Robb concludes: "One hundred million years of facial evolution may be summed up in the expression—slope = 0·66", but points out that a logarithmic equation would also express the size relation between face and cranium.

Careful inspection of Robb's graph suggests that the points do not follow a linear trend, and his method of plotting face-length against total skull-length, which includes the former dimension, will tend to obscure any exponential size relation between face and cranium. In fact, when face is plotted against cranium-length (= total skull minus face-length) on a double logarithmic grid, we get the results shown in the figure. Here, we have included all Robb's measurements of fossil horses except those stated by him to have suffered distortion in fossilization, and to his series of modern horses we have added measurements of seventy-six specimens from the British Museum and other sources. The measurements are those defined by Robb in his paper.

Members of the genus Equus have been grouped together, and means only have been plotted for successive size ranges of cranium-length (crosses on the graph). These means, and the number of specimens contributing to each, are shown in the table below. All points for other genera represent single individuals.



Points for Equus lie on a line (*A*) which has a slope of 1·5 up to a cranium-length of about 15 cm., when it becomes bent to the right with a slope of about 1·0; while a backward extension of the line passes extremely close to the single point for a very small fœtal horse. Of the primitive genera with low-crowned teeth, Eohippus and Mesohippus lie exactly on a line (*B*), which has a slope of about 1·8; while the single point for the European genus Hyracotherium lies quite close to this line, and probably does not deviate significantly from it, in view of the magnification of errors at the lower end of the scale with logarithmic plotting. The aberrant bunodont form Hypohippus lies well to the right of both lines. The other genera are advanced types with hypsodont grinding batteries, and all lie about the line of modern horses (*A*), except for one of the two points for Merychippus, which lies close to (*B*).

Clearly ontogeny does not repeat phylogeny in the evolution of the horse's face, and we propose the following modification of Robb's hypothesis. In primitive ancestral horses of the Eocene and Oligocene, the face grew with simple allometry against the cranium, the growth ratio being about 1·8. With the development of hypsodont teeth in the Miocene (Parahippus, Merychippus), a re-organization of skull proportions occurred, doubtless to make room for the enlarged and specialized grinders, and this seems to have been accomplished, not by an increased rate of facial allometry, but by an increase in the size of the facial rudiment at a very early stage of growth, followed by a lower growth ratio throughout the greater part of development. Further measurements may possibly show that the lines (*A*) and (*B*) should be parallel, that is, that the change was not accompanied by a fall in growth ratio. It is interesting to

note that the re-organization did not occur when the premolars expanded and took on molar pattern in the late Eocene, but only with the evolution of a fully hypsodont grinding battery.

The position of the point for Hypohippus, Osborn's "forest horse", is remarkable. This genus appears to have sprung from a primitive Oligocene stock, was adapted to a forest life, or at least to soft ground and succulent food, and never developed hypsodont teeth. It has a face only three quarters the length of modern horses with the same cranium-length, possibly as a result of a falling off in relative growth-rate parallel to that already noted in Equus.

It is puzzling to find one point for *Merychippus sejunctus* on each of the lines (*A*) and (*B*), but several explanations are possible, such as an error of measurement, or high variability of skull proportions in this species.

The adolescent growth ratio of the face in Equus is not maintained to adult size, but declines quickly to isometry when the colt is 6–8 months old. While this may be an adaptation to increased size, preventing the face from becoming disadvantageously long, it is possibly a result of normal structural changes in late development, such as the eruption of the last molar or the closure of the sutures.

Our analysis has been limited by the fact that only Robb's measurements of fossil genera were available for study. Other indexes of face-length, such as prosthion to posterior edge of tooth arcade or to cribriform plate, might bring out a different aspect of facial evolution. Moreover, there are serious gaps in our data which could probably be filled in from the material in various museums, notably small fœtal specimens of Equus and stages between Mesohippus and Merychippus. Nevertheless, a remarkably close approximation to the allometric law is shown by both the primitive ancestral series and the few immature modern horses, and we publish this study in the hope that others will be able to fill in the main gaps and so test our conclusions.

MEASUREMENTS OF EQUUS SPECIES (IN CENTIMETRES)

Range	No. in group	Cranium-length	Face-length	Range	No. in group	Cranium-length	Face-length
7–9	1	7·3	7·9	17–18	16	17·5	28·8
10–12	3	11·5	16·1	18–19	15	18·5	30·1
12–13	5	12·4	17·5	19–20	13	19·3	31·2
13–14	5	13·3	19·3	20–21	4	20·3	33·8
14–15	4	14·1	21·8	21–22	10	21·3	35·1
15–16	10	15·5	24·5	22–25	5	22·9	37·3
16–17	12	16·5	26·9	25+	1	26·0	43·0

It is a pleasure to acknowledge our indebtedness to the authorities of the British Museum (Natural History), who kindly allowed us access to their collection of skulls. The original data will be deposited in the library of the Museum.

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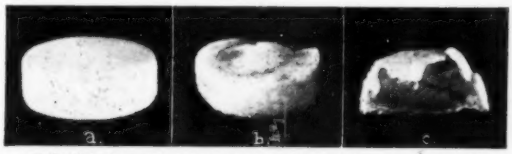
'Ghost' Formation in Subcutaneously Implanted Tablets of Synthetic Œstrogens

THE method of administration of sex hormones by subcutaneous implantation of compressed tablets, first described by Deanesly and Parkes[1], is superior to regular injections in that the tablet, at least for some time, is slowly and continuously absorbed and supplies a relatively constant 'physiological' dosage of hormone.

The kinetics of tablet absorption have been studied[2,3], and the formation of fibrous capsules around tablets implanted into rats[3], rabbits[4], goats[5] and human beings[6,7] described. Geist *et al.*[6] believe that encapsulation may retard absorption and eventually prevent it altogether. Data collected in this laboratory on the absorption from tablets of diethylstilbœstrol and hexœstrol subcutaneously implanted into bovines have indicated that absorption falls off with time at a greater rate than can be accounted for by the decrease in the surface area of the tablet. Encapsulation, which has been observed in most cases, might account for this, but the new phenomenon reported below may be a factor of even greater importance.



(*a*) Tablet of pure hexœstrol, originally weighing approximately 1 gm., after implantation into a cow for 63 days.
(*b*) Ghost obtained by ether extraction of a similar tablet.
(*c*) Ghost cut in half showing hollow structure.

It was observed that tablets of hexœstrol or diethylstilbœstrol, which had been removed from bovines and, after careful cleaning, soaked in several changes of distilled water and dried at room temperature over calcium chloride, were not completely soluble in alcohol or ether, a flocculent residue remaining in suspension. When such a tablet was gently refluxed with alcohol or ether, it appeared to be insoluble, though it was evident that œstrogen was being extracted. The tablet gradually assumed a yellowish translucent appearance and eventually began to float.

Examination showed that the tablet now consisted of a fragile, hollow body of the same shape, and very little smaller than the original tablet (see accompanying illustration), but composed of ether-alcohol insoluble material. This structure, for which I propose the name 'ghost', is evidently formed *in vivo* by infiltration into, and deposition of tissue protein in, the pores of the surface zone of the tablet. Its presence in the tablet is invisible to the naked eye until the œstrogen 'skeleton' has been dissolved away.

In the desiccator the ghosts shrink considerably, forming horny masses which are insoluble in water, acids and alkalis. Tests for nitrogen, sulphur and phosphorus were positive. When a fragment is burnt, it first swells, chars and gives off a smell of burning wool. It probably consists mainly of a scleroprotein formed as a result of the reaction of the animal tissues to the presence of a foreign body.

As yet only tablets of synthetic œstrogens removed from bovines have been shown to contain ghosts. It remains to be seen whether this applies also to

DRY WEIGHTS OF GHOSTS FORMED IN HEXOESTROL TABLETS SUBCUTANEOUSLY IMPLANTED INTO BOVINES

Wt. of tablet (*a*) after removal from animal (mgm.)	Absorption (mgm.)	Wt. of ether or alcohol extract (*a*) (mgm.)	Wt. of ghost (*b*) (mgm.)	Approx. percentage error in determination of the absorption. Calculated from	
				(*a*)	(*b*)
894*	172	810§	30·5	49	18
889*	172	855	19·5	20	11
742†	362	644	37·5	22	10
849‡	272	811	24·5	14	9

* Five similar tablets weighing 5,240 mgm. were implanted. The absorption from this single tablet is taken as one fifth of the total absorption.

† Twenty similar tablets weighing 1,104 mgm. were implanted.

‡ One tablet weighing 1,121 mgm. was implanted.

§ This extract was re-dissolved in ether, the ethereal solution repeatedly extracted with NaOH, then washed, dried over Na_2SO_4, and the ether distilled off. An oily residue weighing 13·7 mgm. remained. The ghosts may therefore contain some fatty material.

tablets removed from other animals or to tablets of steroid hormones.

Two points in connexion with ghost formation may be of practical importance. First, failure to allow for the weight of the ghost in determining absorption rates by weighing tablets before and after implantation may result in errors amounting to 10–20 per cent (see accompanying table). Second, it seems probable that the infiltration of the 'cortex' of the tablet with so insoluble a substance may considerably retard absorption and perhaps ultimately stop it completely. This would seem to be a likely explanation of the observation of Foss[7] (in the only case in which he used a tablet more than once) that an œstrone tablet removed from a woman and, after cleaning and sterilizing, implanted into another patient, underwent no further absorption.

The effect of ghost formation on absorption, together with the biochemical, serological and histological aspects of the phenomenon, are being further investigated.

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Vitamin C and Chromosome Number in Rosa

FIVE years ago Bukin and Zubkova[1] found that wild rose hips contained higher proportions of ascorbic acid when they came from the more northerly or more mountainous regions of the U.S.S.R., proportions rising in the Cinnamomæ group to 15 per cent of the dry weight. It had been known since Täckholm's work[2] that species, or rather forms, in Rosa with the more arctic or alpine distribution were the higher polyploids. Evidently in Rosa[3], as elsewhere[4], there had been a freer post-glacial colonization by the forms with higher chromosome numbers. It seemed therefore that an increase of chromosome number in the rose (as in the apple[5] and perhaps the tomato[6]) might inherently lead to an increase of vitamin production in the fruit, or in the plant generally.

The species named by the Russian chemists as having the highest vitamin contents are in fact recorded by cytologists in other countries as tetraploid, hexaploid and octoploid. Where, however, as in Rosa, polyploidy has occurred within the species, that is, without great morphological change, the systematic name has necessarily lost its genetic and physiological meaning. It is not possible therefore to test the effect of polyploidy until chemical and cytological examinations can be made on the same series of plants.

We are now nearer this goal with the chemical work of Pyke and Melville[7] on species of which representatives in Great Britain have also been examined cytologically. These workers likewise have found that the more northerly forms have the higher vitamin contents, even, they remark, when transplanted to the south. Their facts in relation to the chromosome numbers, so far as I can trace them, are summarized in the accompanying table:

VITAMIN C IN FRUITS OF ROSE SPECIES.

Section	Species	Ascorbic acid	Ploidy	Reference
Synstylæ	*arvensis*	0·08%	2*x*	11
Pimpinellifoliæ	*spinosissima*	0·34%	4*x*	11
Caninæ	*micrantha*	0·40%	5*x*	10
,,	*agrestis*	0·46%	,,	10
,,	*canina*	0·55%	,,	8, 11
,,	*dumetorum*	0·59%	,,	11
,,	*tomentosa*	0·69%	,,	11
,,	*rubiginosa*	0·81%	,,	10, 11
,,	*coriifolia*	1·08%	,,	11
,,	*Sherardi*	1·24%	6*x**	9
,,	*mollis*	1·26%	8*x**	9

* Scottish forms; lower polyploid forms found in England

This provisional arrangement indicates that genetic differences determining vitamin content, irrespective of chromosome number, distinguish species within the Caninæ, but that these differences are of a lower order than those distinguishing the larger groups, Caninæ and Cinnamomæ. At the same time they indicate that polyploidy goes with, and may in itself determine, an increase in vitamin production. This conclusion can be tested by the experimental doubling of the chromosome number in diploid and tetraploid forms, and the results will probably have both particular and general value.

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Anemotaxis in Drosophila

Cole[1] has observed that *Drosophila melanogaster* sometimes walks against an air current. Flügge[2] showed that this reaction only occurred when the air was scented, and must therefore be regarded as orientation by smell. However, reactions to air currents without smell do occur in Drosophila.

Comparing several species of the genus, a division can be made between those which show a distinct positive anemotaxis and those which do not. *Drosophila virilis* +, *D. virilis americana*, *D. subobscura* and *D. funebris* turn very sharply towards a tube from which air is flowing and start walking against it, so long as they are not blown away. *D. melanogaster* and *D. buskii*, on the other hand, show no reaction, whereas *D. pseudo-obscura* shows a slight reaction.

Removal of the wings or antennæ or both does not abolish the reaction in the species showing it. Therefore Fraenkel and Gunn's[3] contention that anemotaxis depends on the perception of body deformation caused by the wind seems plausible for Drosophila.

The fact that the two light species observed do not react to wind whereas the four dark species do, may be an indication that the former are not exposed to strong air currents in their natural environment, while the latter are. As wind is a factor which increases evaporation, this is in agreement with some recently published deductions[4], to the effect that a dark cuticle provides better protection against desiccation than a light one.

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Nomenclature of Biological Movement

Having read recently with very great interest Fraenkel and Gunn's "Orientation of Animals", I set about making for my own clarification a classification of all the cases I know of what used to be called 'tropistic' movements.

It is clear that three major groupings are possible: a *taxis*, which is a bodily movement of an animal or motile plant in a direction determined by the direction of the stimulus; a *kinesis*, which is a change of rate of movement of an animal (or perhaps motile plant) in response to a change of intensity of a stimulus, but not in a direction determined by the direction of the stimulus—and often producing an aggregating effect superficially similar to that of a taxis; and an *orientation*, which is the placing of the body (usually if not always animal) in a direction determined by the direction of the stimulus. To these three classes many of the cases can be referred.

But the responses of sessile plant organs do not seem to be so conveniently classified. The thigmotropism of Clematis tendrils appears to warrant that name, for the response is a directional one. But the same cannot be said of the so-called 'thigmotropism' of Mimosa leaflets, Mimulus stigma or Berberis stamen, for here the response is not in a direction determined by that of the stimulus. The response in these cases appears to bear a closer resemblance to the photonasty of Oxalis leaflets and the thermonasty of Tulipa flowers. Is one then justified (disregarding—as often becomes necessary for purposes of coherence—mere etymological niceties) in putting these responses under the heading of 'thigmonasty' (or possibly in some cases—as in Stiles's "Plant Physiology"—'seismonasty')? By the same token may the response of Mimosa leaflets to a lighted match in the neighbourhood be called a 'thermonasty', and to ammonia vapour, a 'chemonasty'?

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An Inland Record of *Triglochin maritimum* L.

In a previous note[1] I recorded the occurrence of the halophilic alga *Percursaria percursa* Rosenv. from a salt-spring situated at Aldersey[2], Cheshire. Continuing the ecological survey of this spring, I am now able to report the presence of the halophyte *Triglochin maritimum* L. (Naiadaceæ). It occurs in three small colonies growing in the salt-spring and appears to be well established. I should add that during the past year the spring has maintained a salinity of 1,642 parts per 100,000 with only slight variation.

Triglochin maritimum, popularly known as seaside arrow-grass, is a plant frequently found in salt marshes. Its occurrence in a non-littoral region is exceptional and would seem to be unique in so far as the county of Cheshire is concerned. Search of the literature has revealed the fact that Triglochin has occasionally been recorded from the counties of Cambridgeshire, Staffordshire and Surrey.

In Cambridgeshire, the plant appears to have been first reported from Tydd Marsh by Skrimshire[3]. A. E. Evans[4], however, points out that it was never plentiful in that county and has not been found there during recent years. In Staffordshire, J. E. Bagnall[5] mentions records of Triglochin by the independent observers, Shaw, Stokes and Brown. In Surrey, C. E. Britton[6] records its discovery by W. A. Todd from the Thames near Putney.

I am indebted to Mr. A. A. Dallman, of Doncaster, for certain of the references quoted.

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Existence of Electromagnetic-Hydrodynamic Waves

If a conducting liquid is placed in a constant magnetic field, every motion of the liquid gives rise to an E.M.F. which produces electric currents. Owing to the magnetic field, these currents give mechanical forces which change the state of motion of the liquid.

Thus a kind of combined electromagnetic-hydrodynamic wave is produced which, so far as I know, has as yet attracted no attention.

The phenomenon may be described by the electrodynamic equations

$$\text{rot } H = \frac{4\pi}{c} i$$

$$\text{rot } E = -\frac{1}{c}\frac{dB}{dt}$$

$$B = \mu H$$

$$i = \sigma(E + \frac{v}{c} \times B);$$

together with the hydrodynamic equation

$$\partial \frac{dv}{dt} = \frac{1}{c}(i \times B) - \text{grad } p,$$

where σ is the electric conductivity, μ the permeability, ∂ the mass density of the liquid, i the electric current, v the velocity of the liquid, and p the pressure.

Consider the simple case when $\sigma = \infty$, $\mu = 1$ and the imposed constant magnetic field H_0 is homogeneous and parallel to the z-axis. In order to study a plane wave we assume that all variables depend upon the time t and z only. If the velocity v is parallel to the x-axis, the current i is parallel to the y-axis and produces a variable magnetic field H' in the x-direction. By elementary calculation we obtain

$$\frac{d^2H'}{dz^2} = \frac{4\pi\partial}{H_0^2}\frac{d^2H'}{dt^2},$$

which means a wave in the direction of the z-axis with the velocity

$$V = \frac{H_0}{\sqrt{4\pi\partial}}.$$

Waves of this sort may be of importance in solar physics. As the sun has a general magnetic field, and as solar matter is a good conductor, the conditions for the existence of electromagnetic-hydrodynamic waves are satisfied. If in a region of the sun we have $H_0 = 15$ gauss and $\partial = 0{\cdot}005$ gm. cm.$^{-3}$, the velocity of the waves amounts to

$$V \sim 60 \text{ cm. sec.}^{-1}.$$

This is about the velocity with which the sunspot zone moves towards the equator during the sunspot cycle. The above values of H_0 and ∂ refer to a distance of about 10^{10} cm. below the solar surface where the original cause of the sunspots may be found. Thus it is possible that the sunspots are associated with a magnetic and mechanical disturbance proceeding as an electromagnetic-hydrodynamic wave.

The matter is further discussed in a paper which will appear in *Arkiv för matematik, astronomi och fysik*.

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Energy of Dissociation of Carbon Monoxide

THE energies of dissociation of a number of diatomic molecules have been determined from spectroscopic data, apparently with high accuracy, by the observation of predissociation limits. During the last few years the following values have been proposed for CO: $D(\text{CO}) = 6{\cdot}92$ [1], $8{\cdot}41$ [2], $9{\cdot}14$ [3], $10{\cdot}45$ [4] e.v.; while values of $9{\cdot}85$ and $11{\cdot}11$ also appear possible[3]. Controlled electron experiments suggest $9{\cdot}6$ [5].

The value obtained by extrapolation of the vibrational levels of the ground state is about 11, and support for this value has been given by Kynch and Penney[6]. Herzberg[7] has recently summarized evidence favouring $9{\cdot}14$.

At first sight, the strongest argument for $9{\cdot}14$ is the observation by Faltings, Groth and Harteck[8] that CO is decomposed by the xenon line at 1295 A., but not by that at 1470 A., from which they conclude that $8{\cdot}44 < D(\text{CO}) < 9{\cdot}57$. This conclusion is not based on an examination of the initial act of absorption. The only known absorption in the 1295 A. region is that corresponding to the fourth positive bands. The origins of the (9,0) and (10,0) bands lie at 76,839 cm.$^{-1}$ and 78,010 cm.$^{-1}$. The xenon line 1295 A. = 77,172 cm.$^{-1}$ falls between these bands and, if absorbed from the lowest vibrational level of CO, would correspond approximately to the line $P(35)$ of (10,0). This gives as the upper limit of $D(\text{CO})$ (when the rotational energy is taken into account) a value of 79,722 cm.$^{-1}$ = 9·88 e.v. (not 9·57 e.v. as stated by Herzberg[7]). Actually, it is doubtful whether such a high rotational line as $P(35)$ would be observed at room temperature, and absorption, if it is due to CO, would probably occur from a higher vibrational level, corresponding perhaps to the (13,2) band, in which case the dissociation limit may be placed as high as $10{\cdot}1$.

Taking the first act of absorption as

$$\text{CO}(X^1\Sigma) + h\nu = \text{CO}(A^1\Pi),$$

and assuming a life not less than 10^{-8} sec. for $A^1\Pi$, then at atmospheric pressure each molecule experiences at least 100 collisions before radiating. It seems to us that this gives a reasonable chance for a reaction such as

$$\text{CO}(A^1\Pi) + \text{CO}(X^1\Sigma) = \text{CO}_2 + \text{C}$$

to proceed with quantum efficiency approaching unity. The state of the carbon atom might be either ^1D or ^3P; the former if spin is to be conserved, the latter if not. In either case the reaction is strongly exothermic. The failure of the xenon line 1470 to induce photodissociation may be due to the reaction requiring an activation energy.

Estimates of $D(\text{CO})$ less than 10 take no account of the non-crossing rule of Hund, and Neumann and Wigner[9]. This rule states that potential energy curves of molecular states of identical species cannot cross. Whether the rule is rigorous when the nuclear and electronic motions are not separated needs further examination, but at least we see no reason for anticipating a failure of the rule in the lowest energy curve of CO. If this curve has only one turning point then the non-crossing rule requires unequivocally that $D(\text{CO}) > 10{\cdot}3$, and would agree well with the predissociation limit at $11{\cdot}11$ e.v.

The dissociation energy of CO^+ is $2{\cdot}6$ e.v. less than that of CO ($D(\text{CO}^+) = D(\text{CO}) + I(\text{C}) - I(\text{CO})$). Three electronic states of CO^+ are known, namely, $X^2\Sigma^+$, $A^2\Pi$ and $B^2\Sigma^+$, extrapolating to dissociation limits of about $9{\cdot}8$ (a very long extrapolation), $9{\cdot}2$ and $9{\cdot}4$ e.v. respectively. Since the two $^2\Sigma^+$ states must give different products of dissociation, it would appear, on the evidence of the $B^2\Sigma^+$ state, that $D(\text{CO}^+)$ is $7{\cdot}4$, and $D(\text{CO})$ is about 10, and on the evidence of the $A^2\Pi$ state that $D(\text{CO}^+)$ is $9{\cdot}2$ and $D(\text{CO})$ is $11{\cdot}8$. All that may fairly be deduced from present evidence on CO^+ is that $D(\text{CO})$ is unlikely to be much less than 10.

We have also re-examined nitrogen. The accepted value $D(\text{N}_2) = 7{\cdot}38$ is based on the identification of the upper state of the Vegard–Kaplan bands with the

$^1\Sigma$ level. This is at variance with numerous measurements of the excitation potential of the second positive bands[10]. Applications of the non-crossing rule to N_2 and N_2^+ agree in giving $D(N_2)$ at about 9 e.v., but it is only possible to avoid crossing of the N_2 potential curve for $B^3\Pi$ and another $^3\Pi$ state dissociating to $^4S + {}^2D$ by assuming a small maximum in the $B^3\Pi$ energy curve. We incline to the opinion that many of the upper potential curves of CO and similar molecules must have more than one turning point: without such an assumption it is difficult to make the various lines of experimental evidence fit together. Details will be given later.

Summarizing, our suggestions are that D(CO) lies between 9·85 and 11·11 e.v., and $D(N_2)$ is about 9 e.v.

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A Modified Patterson Function

RECENTLY Yü has suggested in NATURE[1] the synthesis of a new modification of the Patterson function, which has proved very useful in structure analysis of crystals. For the one-dimensional case, Yü's method is to calculate the modified function P_u given by the following series

$$P_u = \sum_h a_{uh} E_h \qquad (1)$$

at the points $X_n = \frac{n}{N}$, where N (taken to be an even number for the convenience of our discussion) is the number of equal sub-divisions into which the unit translation is to be divided, and the E's are the 'idealized' structure factors with atomic numbers replacing the appropriate atomic factors. When the constants a_{uh} are so determined that

$$E_h = \sum_{n=-Na}^{+Na} P_n \cos 2\pi h X_n \qquad (2)$$

for every vector h of the reciprocal lattice, the function P_n gives an approximate representation of the product Z_iZ_j or a sum of such products corresponding to one or more interatomic vectors $r_{ij} = X_n$, provided that N is chosen sufficiently large and the series (1) is not cut off at too small values of h. These constants a_{uh} can be determined from the following relation:

$$\sum_{n=-N2}^{+N2} a_{nh} \cos 2\pi h' X_n = (-1)^h \cdot \frac{h'.\sin h'\pi}{\pi(h'^2 - h^2)}. \qquad (3)$$

Evidently, Yü's method admits of easy generalization to two- or three-dimensional cases, which require another set of constants b_{vh}, to be determined by the following relation:

$$\sum_{n=-N2}^{+N2} b_{nh} \sin 2\pi h' X_n = (-1)^h \cdot \frac{h.\sin h'\pi}{\pi(h'^2 - h^2)}. \qquad (4)$$

An obvious disadvantage of this method is the computation of these sets of constants for a moderately large value of N, which is undoubtedly very laborious.

I wish to point out here the simple limiting forms of the constants a_{nh} and b_{nh} when N is allowed to tend to infinity. Equation (3) takes the following form

$$\int_{-\frac{1}{2}}^{+\frac{1}{2}} a_h(X) \cdot \cos 2\pi h' X . dX = (-1)^h \frac{h'.\sin h'\pi}{\pi(h'^2 - h^2)},$$

when N becomes infinite. It follows immediately that $a_h(X) = \cos 2\pi hX$. Similarly, $b_h(X) = \sin 2\pi hX$. It is thus obvious that (1) is an approximate form of Fourier representation of the 'idealized' Patterson function. It differs from the Patterson function in the fact that the E's (which can only be approximately determined from the experimental intensities) are used instead of the $|F|^2$'s; this difference accounts for the possible 'sharpening' of the Patterson peaks in Yü's modified function. Hence it may be inferred that (1) will not be more rapidly convergent than the Patterson function if the same degrees of approximation are to be attained; and that it will not entirely eliminate the diffraction effects inherent in the latter function or other related Fourier representations because of experimental limitations and uncertainties. Although I agree with Yü in realizing the desirability for a new interpretation of the Patterson function or related functions, it is my opinion that Yü's method does not offer a better solution to the structure analysis of crystals than the original function of Patterson.

CHIA-SI LU.

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[1] Yü, S. H., **149**, 638 (1942). Cf. also a note on p. 729. The paper of S. H. Yü and C. P. Ho (*Science Records, Academia Sinica*, 1 (1942)) is not available here for reference.

Radiation from Flames

As is well known, R. von Helmholtz found that the radiation from carbon monoxide flames was nearly 2·5 times as great as that from hydrogen flames. This appears to be generally interpreted as indicating that carbon dioxide radiates more powerfully than water vapour[1]. But the opposite is the case; water vapour radiates twice as powerfully as carbon dioxide under similar conditions of temperature, etc[2,3]. Helmholtz's results (which at first sight are all the more surprising because hydrogen-air flames are some 100° C. higher in temperature than carbon monoxide-air flames) would appear to be due to the more rapid cooling of the hot products surrounding the outer cone in the case of hydrogen flames than in the case of carbon monoxide flames, for Hartley[4] has shown that the overwhelming proportion of the radiation from flames comes not from the interconal gases but from these hot products. It would appear that the more rapid the combustion the greater the turbulence in these products, and hence, owing to the more effective intermingling with the surrounding air, the more rapid the cooling.

Helmholtz also found that when the gases fed to the burner were pre-heated the amount of radiation from the flame was decreased—in spite of the fact that the flame gas temperature must be higher. He and others believed that this supported the view that the (infra-red) radiation from flame gases is of chemical origin, but there is now definite experimental evidence

that it is due to thermal causes[2]. I think that the explanation of Helmholtz's pre-heating experiments is probably similar to that given above, namely, a more rapid cooling of the hot products outside the outer cone due to greater turbulence.

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Aug. 25.

[1] For example, Bone and Townend, "Flame and Combustion in Gases", (Longmans, Green and Co. (1927), p. 207); and Gaydon, "Spectroscopy and Combustion Theory" (Chapman and Hall, 1942), p. 93.
[2] David and Parkinson, *Phil. Mag.*, **15**, 177 (1933), and unpublished experiments.
[3] Hottel and Egbert, *Trans. A.S.M.E.*, **63**, 297.
[4] *Trans. Inst. Gas Eng.*, 466 (1932-33).

Publication of Scientific Research carried out by Industry

ON p. 322 of NATURE of September 12, Dr. Denbigh charges "many British firms" with refusing to allow their staffs to publish their scientific work. He proceeds to write of "industrial companies" without qualification, and to draw a general comparison between British and American industry. It seems, therefore, that by "many" he means "practically all". Accordingly, it should be pointed out that there is at least one important firm to which his statements do not apply, and, therefore, that evidence is needed to show that the practice he denounces is typical of British industry.

When I became an employee of the General Electric Co., Ltd., twenty-three years ago, I was impregnated with the academic tradition about publication. During those years I have had the fullest opportunity to observe the policy of my employers in this matter, and I can testify that I have never found anything contrary to the highest form of that tradition. Even those of them who are most fully imbued with commercial ideas, and might be expected to take the narrowest view of the company's interest, have realized that the indirect benefits of publication (one of them is a good reputation in academic circles) outweigh any direct benefits of secrecy. Publication in the academic sense has always been regarded as a normal activity of the research staff, and has been subject only to such censorship as a professor might impose on his students to prevent the publication of immature work. Apart from formal publication, the staff have always been encouraged to place their special experience at the disposal of individual academic workers to whom it might be of value. The only restriction, arising out of commercial considerations, has been a delay of perhaps a fortnight on a few occasions in dispatching a paper (or a letter to NATURE), in order to allow a patent specification to be filed.

I do not say that no detail of any industrial process has ever been kept secret; but the few secrets that have been kept (apart of course from those affecting national security) are, in my opinion, of no interest to anyone but a commercial manufacturer.

Those who are still under the delusion that secrets are the life-blood of industry may find it difficult to believe that any firm could long pursue so enlightened a policy. It may be well, therefore, to point out two things. First, the industrial use of many scientific discoveries can be adequately protected by patents, which involve publication. Second, most industrial problems have several alternative solutions. What a manufacturer usually would like to learn from his competitors is not simply how to do something, but the way of doing it that has been found the best. The method most scientifically interesting is by no means always the most commercially effective. By publishing scientific work that indicates some new alternative, a manufacturer does not disclose the method he is actually using.

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Scientific Literature for Enemy Prisoners of War

A SMALL organization has recently been formed[1] for the purpose of sending copies of scientific papers to scientists who are enemy prisoners of war in British hands. The idea is to keep alive the spirit of discovery, so that imprisoned enemy scientists may be helped to remain mentally active and thus become useful world-citizens again after the War.

All the authorities who have been approached have been sympathetic and helpful. This applies to the Director of War Prisoners, the Special Division of the Swiss Embassy concerned with the welfare of German, Italian and Japanese prisoners, Le Comité international de la Croix-rouge (London Delegation), and the War Prisoners Aid Section of the Young Men's Christian Association. The helpfulness of Mr. John Barwick, of the latter organization, must be particularly mentioned.

Scientists receive many reprints of scientific papers which they do not want to keep permanently. I should be most grateful for reprints, which would be directed through the proper channels to the appropriate scientists in prisoner-of-war camps. Fairly old papers would be useful as well as new ones. Enemy prisoners are unlikely to have seen British or American papers published later than August 1939, and many earlier ones would also be useful. Copies of NATURE would be particularly acceptable, and some of those who receive this journal regularly may perhaps consider contributing their copies after reading them at leisure. Authors are asked to send reprints of their own papers.

Those who are willing to contribute reprints or copies of NATURE or other journals should send them to me at Burnt Oak, Kidlington, near Oxford. They are asked to give their names, so that they may receive acknowledgements and periodical reports on the progress of the scheme.

No time will be spent on the organization of this scheme which would otherwise be spent on the war effort.

Scientists who are not already sending educational books to British prisoners in enemy hands may care to know that this can be done through the office of the Educational Books Section of the Prisoners of War Department of the British Red Cross Society and Order of St. John of Jerusalem, at the New Bodleian Library, Oxford. This office is kindly keeping in touch with our movement, so that matters of mutual interest may be discussed.

JOHN R. BAKER.

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Kidlington,
Near Oxford.

[1] Baker, J. R., *New Statesman and Nation*, July 18, p. 43.

FUNCTION OF SOIL CRACKS

By Dr. A. SREENIVASAN

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A CHARACTERISTIC feature of heavy soils such as the black cotton soil is their extensive cracking during summer fallow. Wide fissures are formed as a result of the shrinkage of the soil colloids under the baking action of the hot sun during summer months. These cracks vary from a fraction of an inch to 3–4 in. in width, and are often several feet in depth. It is generally recognized that cracking results in an improvement in the physical properties of the soil, but the factors which determine the character of cracking in field soils have remained rather obscure. Interesting information has been obtained in the course of a survey of the nature and extent of surface cracking in different fields under cotton in the Institute area. The technique adopted was as follows:

The fields were left undisturbed after the last cotton picking towards the end of January. At the hottest part of the year in mid-May, five plots measuring 10 ft. by 10 ft. were marked out at random in each field. Each of these plots was further subdivided into 100 squares, 1 sq. ft. each, and a survey of all the cracks intercepting the lines of these smaller squares mapped on graph paper. Crack width was measured with a straight edge and, where necessary, by using a pair of dividers. The width was measured along a direction perpendicular to the line of interception with the crack.

The number of cracks of different widths obtained as above in typical fields of known rich, medium and poor fertility are given below (Table 1).

Table 1. Frequency of cracking in different fields.

Width of crack* (in.)	Number of cracks (average per plot)			Remarks	
	Field 7: Good, well-drained	Field 41*s*: Medium well-drained	Field 27: Poor, badly drained and eroded	Significance	Critical difference (No. of cracks)
0·5 and less	78·8	16·2	0·4	$P < 0·01$	18·4
0·5–1·0	60·0	37·4	4·6	$P < 0·01$	13·5
1·0–1·5	20·2	28·4	31·0	Insig.	—
1·5–2·0	47·6	35·0	23·4	$P < 0·01$	6·5
2·0–2·5	39·6	37·6	34·0	Insig.	—
2·5–3·0	4·6	4·4	7·2	Insig.	—

* There were few, if any, cracks of width greater than 3·0 in.

Cracking was, on the whole, extensive in the good field, but only meagre in the poor field, the medium field being intermediate in character (see accompanying photographs). The chief difference between the three fields lay in the significantly larger number of small cracks (less than 1·0 in.) in the well-drained fields as compared to the poor field.

An idea of the surface area of cracking was obtained by multiplying the number of individual cracks falling into different width groups (Table 1) by the average width in each instance and summing up these values for each of the three fields:

Table 2. Index of surface area of cracking (average).

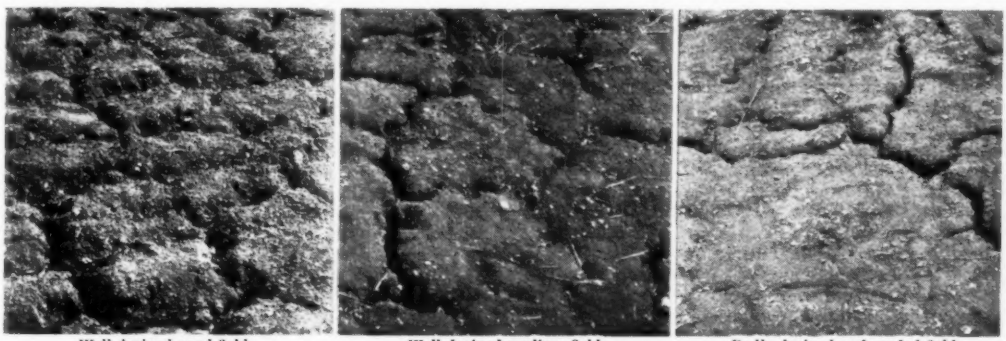
Field 7 (good)	Field 41*S* (medium)	Field 27 (poor)	Significance	Critical difference
275·0	225·6	179·6	$P < 0·01$	34·8

More or less similar results were obtained in surveys carried out over a larger number of fields. It must be emphasized here that these results relate only to fields of the same soil type but differing in their fertility.

No attempt was made to determine the depth of cracking, as it was observed that the fissures leading downward were seldom either vertical or uniform in width. In general, however, the depth to which the cracks extended was often least in fields of low fertility; in other words, the cracking tended to be superficial in these fields. Furthermore, the soil along the cracks in all the fields possessed a friable structure. But, while the soil in the clods from the good and, to a less extent, medium fields also possessed a loose, friable structure, breaking into smaller crumbs with gentle pressure between the fingers, that from the clods of the waterlogged field was usually hard and broke under pressure with a definite cleavage and a somewhat shining surface.

The loose soil in and around the cracks is subjected to alternate heating and cooling during days and nights over considerable periods of time. Such alternate heating and cooling bring about a state of aggregation[1] which, on account of the differences in the degree of cracking, is obviously more uniform throughout the well-drained fields than in the poor field.

Surface (0–6 in.) and sub-soil (6 in.–12 in.) samples for further laboratory examination were taken by a suitably improvised technique from along the cracks and from inside the clods of the fields of medium and poor fertility. These could not be taken from the



Well-drained good field | Well-drained medium field | Badly drained and eroded field

Crack formation in field soils.

rich field as the cracks were too numerous and as, moreover, the soil inside the clods tended to become pulverized readily even under light touch. The results of analyses which will be detailed elsewhere indicated in general that the differences in physical properties between corresponding crack and clod samples were less marked in the well-drained field than in the eroded field. With the latter, there was greater uniformity between surface and sub-soil samples taken along the cracks than from the clods. Thus, the main contrast between the well-drained and poorly drained fields was in the depth to which good tilth existed below the surface.

These observations could be explained as principally due to the fact that, by means of these cracks, considerable quantities of soil material are periodically carried down from the surface to lower depths within the soil, both on account of the hot summer winds and by the early June rains[2]. It is also probable that the first showers of the monsoon are followed by the swelling up of the colloidal masses from below[3]. There is thus a pronounced circulation of the soil material, a result similar to that brought about by cultivation. This 'self-ploughing and sub-soiling'[4] is so intense that mechanical cultivation often becomes ineffective. Experiments carried out for more than five years at this Institute[5] have shown conclusively that summer cultivation with or without inversion to different depths before *Kharif* sowing is not necessary for the rain-sown, unmanured cotton crop. It has been shown similarly that preparatory cultivation on the black soils of Koilpatti (S. India)[6] and in the Sudan[7] is superfluous and may, at times, be decidedly harmful[8]. Even in temperate and cooler regions the effect of the traditional thorough cultivation has begun to be doubted. Thus, at Rothamsted[9], it has been shown that cultivation in excess of that needed to keep down the worst weeds does not confer any further benefit and may even result in a reduction in yield. It would, of course, be useful to adopt summer ploughing in a weed-infested field such as, for example, in the eradication of *kans* (*Saccharum spontaneum*) and *dhub* (*Cyanadon dactylon*), for it is found that hot-weather ploughing exposes and kills the roots[10].

An interesting observation was that the concentration of soluble salts in the soil along the cracks was always higher than in the corresponding sample from the clods (*cf.* Mosseri)[11]. This would suggest the possibility of reclaiming saline lands by promoting crack formation, which will be followed by the washing down with the first rains of the deleterious salts along the crack edges.

Another significant observation related to the rather wide difference in the swelling capacity of the surface and sub-soil samples taken along the cracks, this difference being somewhat less pronounced in the poor field. In either field, the samples from clods did not show any appreciable difference in this property. It would appear that the greater difference with depth in this respect may account for the higher degree of cracking in the well-drained field.

It may be concluded from the foregoing that the development of soil cracks during summer fallow must be promoted. This can be done (i) as already stated, by avoiding, or at any rate reducing to a minimum, cultivation during summer fallow, and (ii) by allowing crop plants to remain in the fields for a certain period (say, until about the beginning of May) after harvesting operations are over. In the latter case, the standing plants will tend to put out ratoon growths. This will be accompanied by deeper penetration of roots followed by new lines of cracking. I have observed that the juxtaposition of crop rows with field cracks have confirmed that standing crops greatly facilitate soil cracking. A possible objection to this practice is that the ratoon crop may deplete the soil of its fertility; while this may be true in some measure, it should be pointed out that if the standing crop is removed by about the middle of the hot season, the recuperative power of the soil during the hot period, coupled with the advantages of better cracking, may offset this depletion. If, however, such crops have had, during their normal period of growth, any disease or insect attack, it may be necessary to pull them out as soon as harvest is over.

It is of interest to compare here the beneficial effects on crop growth resulting from (1) building up of the loose surface soil artificially to different thicknesses[12], and (2) application of 'fired' soil in the sub-surface regions[7, 13]. In heavy soils, the wide cracks formed as a result of extreme variations in swelling and shrinkage is indeed Nature's efficient method of heating and weathering the sub-soil layers. This uniformity with depth in the surface soil will obviously promote greater bacterial activity with consequent production of mucus, which aids in the formation of water-stable aggregates [14, 15].

The advantages of cracking during any one season will admittedly be small, but the cumulative effect over prolonged periods will no doubt be appreciable enough to increase the fertility of a field. Besides, in a waterlogged field, the development of these cracks, followed by the ingress of the surface soil through them, will improve the permeability and drainage conditions in the field.

[1] Bouyoucos, G. J., *Soil Sci.*, **18**, 103 (1924).
[2] Greene, H., *J. Agric. Sci.*, **18**, 518 (1928).
[3] Vageler, P., "An Introduction to Tropical Soils" (London: Macmillan, 1933), p. 179.
[4] Howard, A., "An Agricultural Testament" (Oxford, Univ. Press, 1940), p. 138.
[5] Annual Report, Institute of Plant Industry, Indore (1937).
[6] Ayyar, V. R., Ayyar, S. S., and Tirumalachari, N. C., *Madras Agric. J.*, **28**, 69 (1940).
[7] Annual Report, Gezira Agric. Res. Ser., Sudan Govt. (1937).
[8] Viswa Nath, B., *Agric. and Live-stock in India*, **8**, 9 (1938).
[9] Russell, E. W., and Keen, B. A., *J. Agric. Sci.*, **28**, 212 (1938); Keen, B. A., *J. Min. Agric.*, **45**, 645 (1938).
[10] Howard, A., *Agric. J. Ind.*, **22**, 39 (1927).
[11] Cited from Keen, B. A., "The Physical Properties of the Soil" (London, Longmans, 1931), p. 144.
[12] Sreenivasan, A., NATURE, **148**, 144 (1941).
[13] Sreenivasan, A., and Aurangabadkar, R. K., *Soil Sci.*, **50**, 449 (1940).
[14] Peele, T. C., *J. Amer. Soc. Agron.*, **32**, 204 (1940).
[15] Martin, J. P., and Waksman, S. A., *Soil Sci.*, **52**, 381 (1941).

REBUILDING GREAT BRITAIN

THE Reconstruction Committee of the Royal Institute of British Architects, which has already published five interim reports dealing with planning and amenities, war-time housing, building legislation, reconstruction of the architectural profession and legislation affecting town and country planning in Great Britain, has now issued a first general statement of conclusions, which in some respects provides an interesting parallel to the recent report of the Scott committee.

Dealing first with human needs as a foundation for reconstruction, the statement points out that from the point of view of physical reconstruction, the

essential needs of the individual are suitable work in clean, healthy and cheerful surroundings and a convenient and attractive home, forming part of a community capable of evoking local patriotism and civic pride. The most essential public needs for physical reconstruction are a firmly established agriculture, a prosperous, well-located industry, and an efficient system of transport. As regards the practical and æsthetic needs, the public is right in expecting and demanding that the opportunity afforded by post-war reconstruction shall not be thrown away; buildings and towns must be both convenient for use and pleasant to live in. A civic sense has been slowly but firmly growing up in the people, one form of which is seen in the demand that the slum areas should be no longer tolerated and in regarding the effect of war damage in these areas as an opportunity for total reconstruction. In another form it is seen in the determination to check ribbon development, because that constitutes an offence to the eye, and also in the positive demand that cities and towns should be better to look at and better planned.

In outlining a national plan to meet these needs, the statement points out that assurance is required that the Government's positive policy will deal with individual as well as public needs, and this must be demonstrated by the creation of machinery to produce a national plan as well as to execute it, by the creation of the plan and by its execution. Of these four positive acts the last cannot be contemplated until after the War, but the difficulties in undertaking the other three in war-time must be overcome, at least to the extent of producing the general lines of each before the end of hostilities.

With regard to the machinery of planning, the statement points out that a national authority is essential to obtain a national plan, and at least four Government departments will be deeply involved. Unless all the departments concerned are amalgamated into one huge department, the national planning authority must be so devised that it has the power to co-ordinate the proposals of the various departments and to over-rule the views of any single department when necessary for the sake of the plan as a whole. Some parts at least of the plan will be such that neither private enterprise nor local authority will be able to execute them, and a central executive body will be required to ensure the execution of such work. Accordingly, in addition to a national planning authority and a national planning commission, a development commission will also be required. This commission should be made responsible for ensuring the smooth working of the plan in all developments, whether executed by itself, by Government departments, by local authorities or by private enterprise. It would also be responsible for providing local authorities and public utility companies with the necessary credit for the execution of local schemes. In this connexion attention is directed to the Tennessee Valley Authority as a precedent for public development.

In regard to planning authorities, the organization of the whole would presumably consist of a central planning national authority with its regional officers, and groups of local authorities to prepare the local or sub-regional schemes.

A national code of legislation should be compiled to cover the whole of Great Britain, administered from a single office in each locality. This national code should be in three parts, the first dealing with planning for human needs, or what might be termed a code of living standards. The second would deal with structural standards and the third with the financial provisions which will be necessary to achieve these ends.

It is suggested that the code of living standards might be in two parts dealing respectively with standards of amenity which might be advisory, not compulsory, and with health and safety precautions, which should be mandatory. Under this national code, only one application should be necessary for the approval of plans, but submission of plans for approval should be compulsory for all types of buildings. In addition, the appointment of a national building board is visualized, as outlined in a previous interim report.

In regard to the organization of the building industry, co-ordination of the main groups of the industry, the employers, the operatives, professional bodies and the manufacturers and distributors of building materials can best be achieved through the machinery of a central council which might form a liaison with Government departments. So far as technique is concerned, it is essential that those adopted should provide good building with the utmost possible economy as well as the maximum output, and a proper balance between first cost and cost of maintenance.

Surveys already carried out by the Committee indicate that public control of the building industry must continue after the War, and the techniques adopted in building will affect and be affected by the public policy on imports, transport, etc. Coupled with centralized control, the Committee therefore strongly recommends centralized research, expanded and made independent of outside donations by a sufficient Treasury grant. This centralized research should be under the charge of the Building Research Organization.

In regard to finance, the Committee urges that in drawing up its plans for reconstruction, the Government should relieve local authorities of regions of the financial burden, simplify the machinery for dealing with private interests which may be affected, and arrange for the dispatch and distribution of the resources of the building industry in whatever manner seems best for the national interest. With regard to filling in the plan, it is suggested that all land without exception should be publicly controlled, whether publicly or privately owned.

The great building programmes will be so profoundly affected by any changes in the location of industry that local authorities will only be able to make tentative estimates of their needs until Government policy on this subject is formulated. In the existing large towns or 'conurbations', the need for the centralization is generally agreed, and building of a certain number of new satellite towns is complementary to this decentralization. Regrouping within the boundaries of existing towns is as important as decentralization, and new towns should, when possible, be developed from existing small towns or villages.

A local improvement fund for each district is recommended and a very close relation should exist between the housing and town planning committees in an area. Housing should form part of a well-conceived plan for re-equipping the country, and in that it should incorporate standards fulfilling the desires and requirements of the population, should be able to call for the best technical advice and

knowledge available. The selection of suitable architects requires careful attention. The post-war housing needs cannot be estimated, but the position facing the building industry must be handled on a national, not a local, scale, and only by careful planning ahead can the post-war housing needs be met. The emergency and the long-term programmes must fit into a national scheme which takes account of the future redistribution of industry and of methods of construction. There is no suggestion that the provision of housing by private builders should be discouraged, provided excessive profits on land and buildings are eliminated and that standards both in design and construction are reasonably good. A national policy for house production should be formulated to co-ordinate the work of the various house-building agencies and constitute more even distribution of work and results. Research into consumer needs should also be encouraged.

The final section of the statement deals with the importance of the architect's contribution, both in modern planning and in the public control of the appearance of buildings, and it is stressed that it is essential that every planning authority should employ a well-qualified architect as a principal officer directly responsible to that authority.

LEAD-CALCIUM TEST CASTINGS

CLOSE control of the calcium content is required in the manufacture of lead-calcium cable sheath. This is not easily attainable because the calcium content is small and a variable amount is lost while the alloy is molten, despite the special techniques used to minimize air contact. Conventional methods of determining this loss are slow and costly. A new procedure described by G. M. Bouton (*Bell Lab. Rec.*, **20**, No. 10; June, 1942) arises from Bell Laboratory studies of lead-calcium alloys which have shown that the surfaces of ingots, chill cast with little agitation, become progressively duller with increasing calcium content. Fissuring then sets in and leaves bright areas exposed, depending in extent on the amount of calcium present. Under controlled conditions these markings provide a quick, accurate measurement of the calcium content.

The sample is melted in a small iron crucible, the lip of which is brought close to the mould before pouring, to minimize exposure to the atmosphere. The mould itself is an iron plate with a tapered depression about 4 in. long and $\frac{5}{8}$ in. wide, milled on its surface. To ensure reproducible results, casting is done in a 'Cellophane' chamber through which passes air of known carbon dioxide and moisture content. Since both affect the results, they are first removed by passing the air over potassium hydroxide and calcium chloride. A definite percentage of each is then replaced in the casting chamber, and the melt poured. Representative figures are 50 per cent humidity and 0·02 per cent carbon dioxide. Decreasing moisture and increasing carbon dioxide make the surface brighter, and vice versa. Alloys of calcium content outside the range of the method may be tested by diluting or enriching them with lead-calcium alloys containing appropriate amounts of calcium. This method of determining the calcium content in cable sheath is reliable and more rapid than chemical analysis or metallographic techniques.

FORTHCOMING EVENTS

(Meeting marked with an asterisk is open to the public)

Saturday, October 3

GEOLOGISTS' ASSOCIATION (at the Geological Society of London, Burlington House, Piccadilly, London, W.1), at 2.30 p.m.—Dr. David Williams: "Mineral Resources of the U.S.S.R".

Tuesday, October 6

CHADWICK PUBLIC LECTURE (at the Royal Society of Tropical Medicine and Hygiene, 26 Portland Place, London, W.1), at 2.30 p.m.—Sir Leonard Hill, F.R.S.: "The Interrelation of Clothing and Shortage of Fuel in matters of Health".*

Friday, October 9

INSTITUTION OF MECHANICAL ENGINEERS (at Storey's Gate, St. James's Park, London, S.W.1), at 5.30 p.m.—Mr. E. Watson Smyth: "The Training Activities of the Ministry of Labour".

APPOINTMENTS VACANT

APPLICATIONS are invited for the following appointments on or before the dates mentioned:

HEAD OF ENGINEERING DEPARTMENT (MECHANICAL AND ELECTRICAL) in the School of Mines and Technology, Treforest—The Director of Education, Glamorgan County Hall, Cardiff (October 12).

LECTURER IN ELECTRICAL ENGINEERING—The Secretary, University College, Dundee.

REPORTS and other PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

Report of the Committee on Amenities and Welfare Conditions in the Three Women's Services. (Cmd. 6384.) Pp. 58. (London: H.M. Stationery Office.) 1*s.* net. [149

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